MOSFETs Silicon P-/N-Channel MOS (U-MOSⅥ/U-MOSⅥ-H)

TPC8408

1. Applications

- Mobile Equipments
- Motor Drivers

2. Features

(1) Small footprint due to a small and thin package

(2) High speed switching

(3) Low drain-source on-resistance

P-channel $R_{DS(ON)}$ = 33 mΩ (typ.) (V_{GS} = -10 V),

N-channel $R_{DS(ON)}$ = 24 mΩ (typ.) (V_{GS} = 10 V)

(4) Low leakage current

P-channel I_{DSS} = -10 μA (max) (V_{DS} = -40 V),

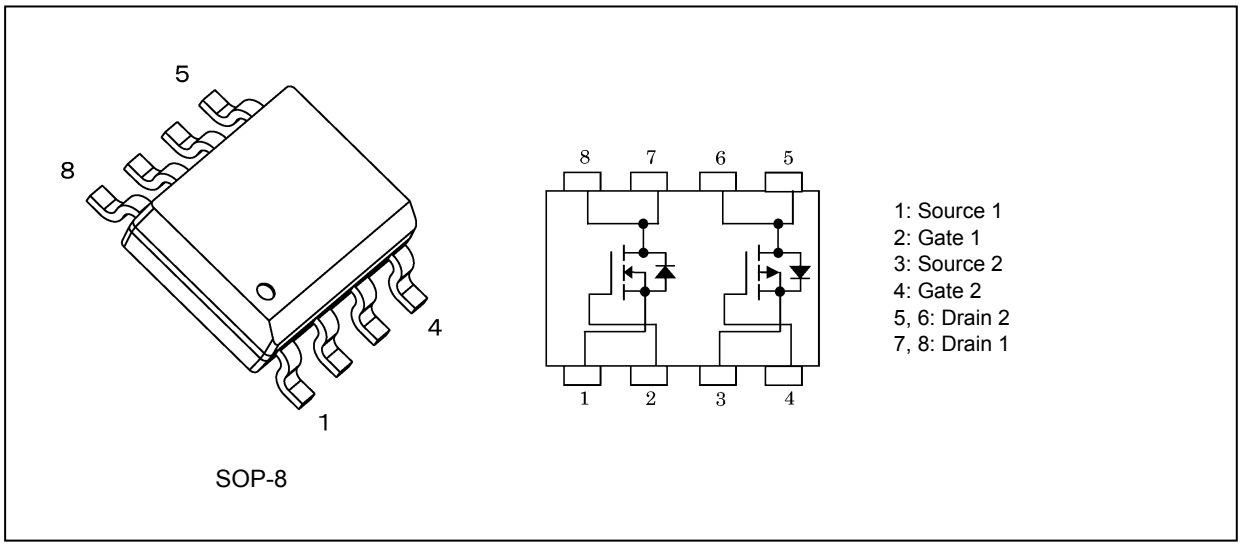
N-channel I_{DSS} = 10 μA (max) (V_{DS} = 40 V)

(5) Enhancement mode

P-channel V_{th} = -0.8 to -2.0 V (V_{DS} = -10 V, I_D = -0.1 mA),

N-channel V_{th} = 1.3 to 2.3 V (V_{DS} = 10 V, I_D = 0.1 mA)

3. Packaging and Internal Circuit



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

Characteristics			P/N	Symbol	Rating	Unit
Drain-source voltage			P-ch	V_{DSS}	-40	V
			N-ch		40	
Gate-source voltage			P-ch	V_{GSS}	±20	
			N-ch		±20	
Drain current (DC)		(Note 1)	P-ch	I_D	-5.3	A
			N-ch		6.1	
Drain current (pulsed)		(Note 1)	P-ch	I_{DP}	-21.2	A
			N-ch		24.4	
Power dissipation (single operation)	(t = 10 s)	(Note 2), (Note 4)	P-ch	$P_{D(1)}$	1.5	W
			N-ch		1.5	
Power dissipation (per device for dual operation)	(t = 10 s)	(Note 2), (Note 5)	P-ch	$P_{D(2)}$	1.1	W
			N-ch		1.1	
Power dissipation (single operation)	(t = 10 s)	(Note 3), (Note 4)	P-ch	$P_{D(1)}$	0.75	W
			N-ch		0.75	
Power dissipation (per device for dual operation)	(t = 10 s)	(Note 3), (Note 5)	P-ch	$P_{D(2)}$	0.45	W
			N-ch		0.45	
Single-pulse avalanche energy		(Note 6)	P-ch	E_{AS}	18	mJ
			N-ch		24	
Avalanche current			P-ch	I_{AR}	-5.3	A
			N-ch		6.1	
Channel temperature			P-ch	T_{ch}	150	°C
			N-ch		150	
Storage temperature			P-ch	T_{stg}	-55 to 150	°C
			N-ch		-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-ambient thermal resistance (single operation)	(t = 10 s)	(Note 2), (Note 4)	$R_{th(ch-a)(1)}$	83.3	°C/W
Channel-to-ambient thermal resistance (per device for dual operation)	(t = 10 s)	(Note 2), (Note 5)	$R_{th(ch-a)(2)}$	113	
Channel-to-ambient thermal resistance (single operation)	(t = 10 s)	(Note 3), (Note 4)	$R_{th(ch-a)(1)}$	166	
Channel-to-ambient thermal resistance (per device for dual operation)	(t = 10 s)	(Note 3), (Note 5)	$R_{th(ch-a)(2)}$	277	

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

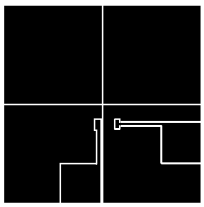
Note 2: Device mounted on a glass-epoxy board (a), Figure 5.1

Note 3: Device mounted on a glass-epoxy board (b), Figure 5.2

Note 4: Power dissipation and thermal resistance values per device with the other device being off (During single operation, power is supplied to only one of the two devices.)

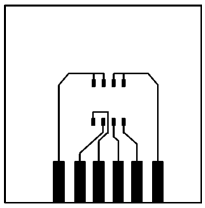
Note 5: Power dissipation and thermal resistance values per device for dual operation (During dual operation, power is evenly supplied to both devices.)

Note 6: P channel: V_{DD} = -32 V, T_{ch} = 25°C (initial), L = 0.5 mH, R_G = 25 Ω, I_{AR} = -5.3 A
N channel: V_{DD} = 32 V, T_{ch} = 25°C (initial), L = 0.5 mH, R_G = 25 Ω, I_{AR} = 6.1 A



FR-4
25.4 × 25.4 × 0.8
(Unit: mm)

Fig. 5.1 Device Mounted on a Glass-Epoxy Board (a)



FR-4
25.4 × 25.4 × 0.8
(Unit: mm)

Fig. 5.2 Device Mounted on a Glass-Epoxy Board (b)

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

6. Electrical Characteristics (T_a = 25°C unless otherwise specified)

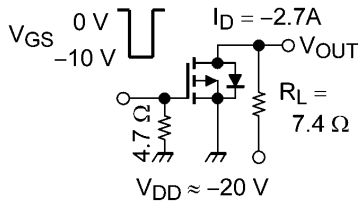
6.1. Static Characteristics

Characteristics	P/N	Symbol	Test Condition	Min	Typ.	Max	Unit
Gate leakage current	P-ch	I_{GSS}	V_{GS} = ±20 V, V_{DS} = 0 V	—	—	±0.1	μA
	N-ch		V_{GS} = ±20 V, V_{DS} = 0 V	—	—	±0.1	
Drain cut-off current	P-ch	I_{DSS}	V_{DS} = -40 V, V_{GS} = 0 V	—	—	-10	μA
	N-ch		V_{DS} = 40 V, V_{GS} = 0 V	—	—	10	
Drain-source breakdown voltage	P-ch	$V_{(BR)DSS}$	I_D = -10 mA, V_{GS} = 0 V	-40	—	—	V
	N-ch		I_D = 10 mA, V_{GS} = 0 V	40	—	—	
Drain-source breakdown voltage (Note 7)	P-ch	$V_{(BR)DSX}$	I_D = -10 mA, V_{GS} = 10 V	-30	—	—	V
	N-ch		I_D = 10 mA, V_{GS} = -20 V	23	—	—	
Gate threshold voltage	P-ch	V_{th}	V_{DS} = -10 V, I_D = -0.1 mA	-0.8	—	-2.0	V
	N-ch		V_{DS} = 10 V, I_D = 0.1 mA	1.3	—	2.3	
Drain-source on-resistance	P-ch	$R_{DS(ON)}$	V_{GS} = -4.5 V, I_D = -2.7 A	—	41	53	mΩ
			V_{GS} = -10 V, I_D = -2.7 A	—	33	43	
	N-ch		V_{GS} = 4.5 V, I_D = 3.1 A	—	28	36	
			V_{GS} = 10 V, I_D = 3.1 A	—	24	32	

Note 7: 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.

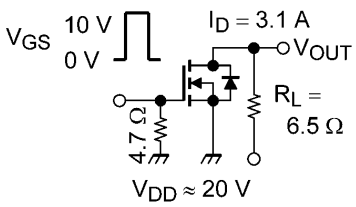
6.2. Dynamic Characteristics

Characteristics	P/N	Symbol	Test Condition	Min	Typ.	Max	Unit
Input capacitance	P-ch	C_{iss}	V_{DS} = -10 V, V_{GS} = 0 V, f = 1 MHz	—	1105	—	pF
	N-ch		V_{DS} = 10 V, V_{GS} = 0 V, f = 1 MHz	—	850	—	
Reverse transfer capacitance	P-ch	C_{rss}	V_{DS} = -10 V, V_{GS} = 0 V, f = 1 MHz	—	135	—	pF
	N-ch		V_{DS} = 10 V, V_{GS} = 0 V, f = 1 MHz	—	40	—	
Output capacitance	P-ch	C_{oss}	V_{DS} = -10 V, V_{GS} = 0 V, f = 1 MHz	—	165	—	pF
	N-ch		V_{DS} = 10 V, V_{GS} = 0 V, f = 1 MHz	—	145	—	
Switching time (rise time)	P-ch	t_r	See Figure 6.2.1.	—	8.1	—	ns
	N-ch		See Figure 6.2.2.	—	2.0	—	
Switching time (turn-on time)	P-ch	t_{on}	See Figure 6.2.1.	—	16	—	ns
	N-ch		See Figure 6.2.2.	—	7.0	—	
Switching time (fall time)	P-ch	t_f	See Figure 6.2.1.	—	33	—	ns
	N-ch		See Figure 6.2.2.	—	2.3	—	
Switching time (turn-off time)	P-ch	t_{off}	See Figure 6.2.1.	—	131	—	ns
	N-ch		See Figure 6.2.2.	—	17	—	



Duty ≤ 1%, t_w = 10 μs

Fig. 6.2.1 Switching Time Test Circuit (P-ch)



Duty ≤ 1%, t_w = 10 μs

Fig. 6.2.2 Switching Time Test Circuit (N-ch)

6.3. Gate Charge Characteristics

Characteristics	P/N	Symbol	Test Condition	Min	Typ.	Max	Unit
Total gate charge (gate-source plus gate-drain)	P-ch	Q_g	V_{DD} ≈ -32 V, V_{GS} = -10 V, I_D = -5.3 A	—	24	—	nC
	N-ch		V_{DD} ≈ 32 V, V_{GS} = 10 V, I_D = 6.1 A	—	14	—	
Gate-source charge 1	P-ch	Q_{gs1}	V_{DD} ≈ -32 V, V_{GS} = -10 V, I_D = -5.3 A	—	3.0	—	nC
	N-ch		V_{DD} ≈ 32 V, V_{GS} = 10 V, I_D = 6.1 A	—	2.6	—	
Gate-drain charge	P-ch	Q_{gd}	V_{DD} ≈ -32 V, V_{GS} = -10 V, I_D = -5.3 A	—	5.3	—	nC
	N-ch		V_{DD} ≈ 32 V, V_{GS} = 10 V, I_D = 6.1 A	—	2.4	—	

6.4. Source-Drain Characteristics

Characteristics	P/N	Symbol	Test Condition	Min	Typ.	Max	Unit
Reverse drain current (pulsed) (Note 8)	P-ch	I_{DRP}	—	—	—	-21.2	A
	N-ch			—	—	24.4	
Diode forward voltage	P-ch	V_{DSF}	I_{DR} = -5.3 A, V_{GS} = 0 V	—	—	1.2	V
	N-ch		I_{DR} = 6.1 A, V_{GS} = 0 V	—	—	-1.2	

Note 8: Ensure that the channel temperature does not exceed 150°C.

7. Marking (Note)

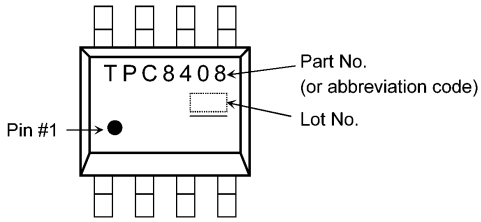


Fig. 7.1 Marking

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. Characteristics Curves (Note)

8.1. P-Channel MOSFET

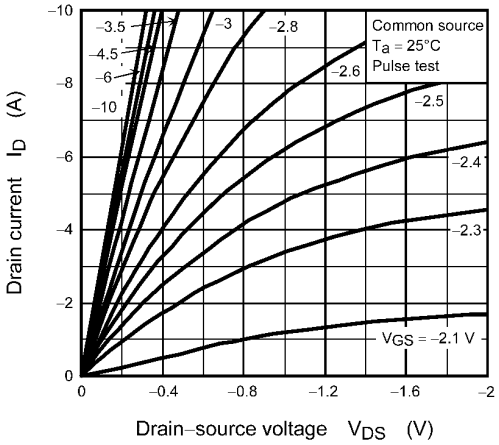


Fig. 8.1.1 I_D - V_{DS}

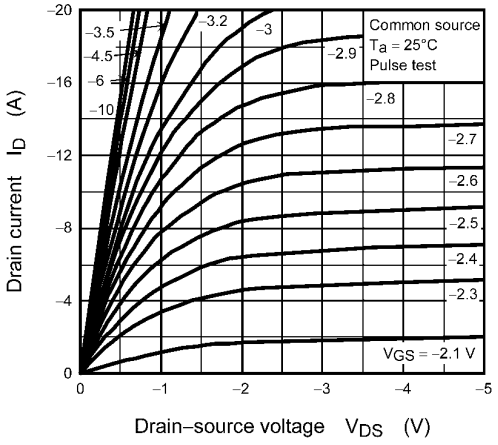


Fig. 8.1.2 I_D - V_{DS}

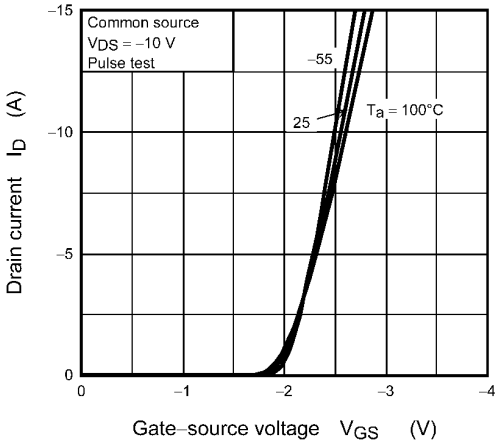


Fig. 8.1.3 I_D - V_{GS}

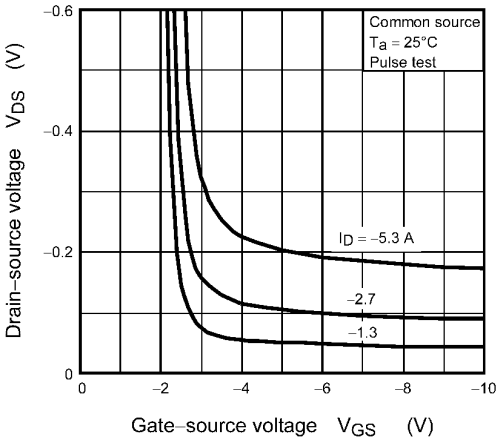


Fig. 8.1.4 V_{DS} - V_{GS}

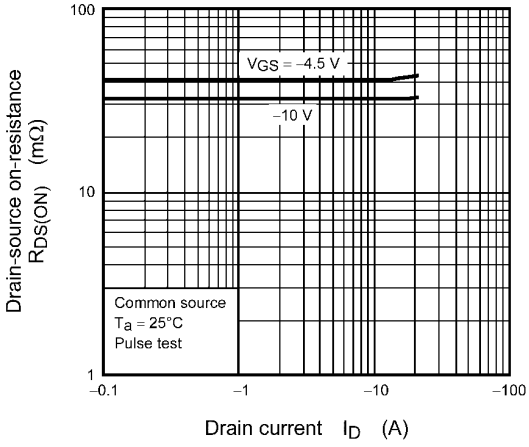


Fig. 8.1.5 $R_{DS(ON)}$ - I_D

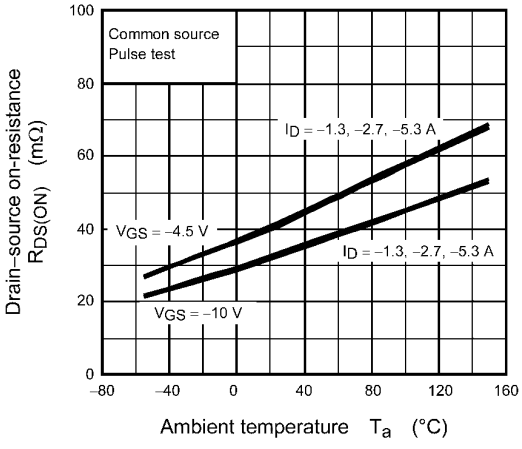


Fig. 8.1.6 $R_{DS(ON)}$ - T_a

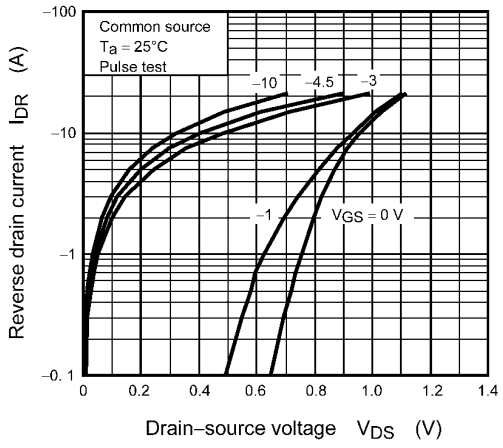


Fig. 8.1.7 I_{DR} - V_{DS}

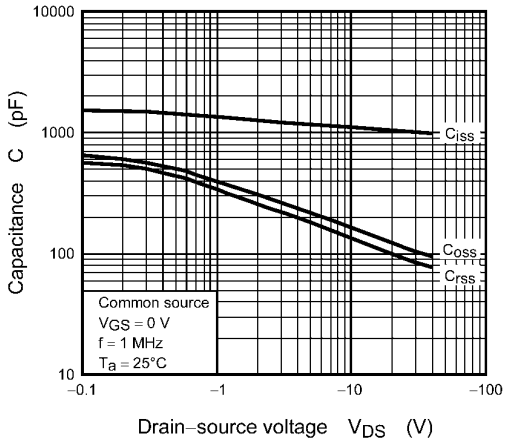


Fig. 8.1.8 Capacitance - V_{DS}

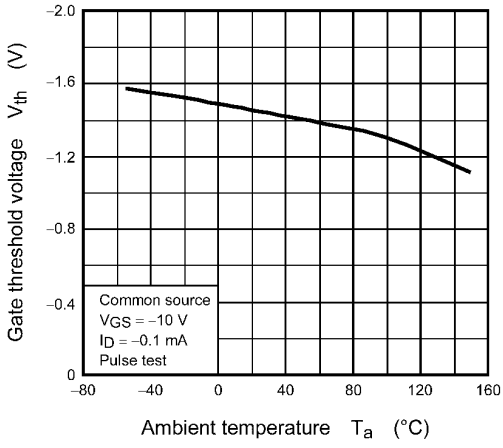


Fig. 8.1.9 V_{th} - T_a

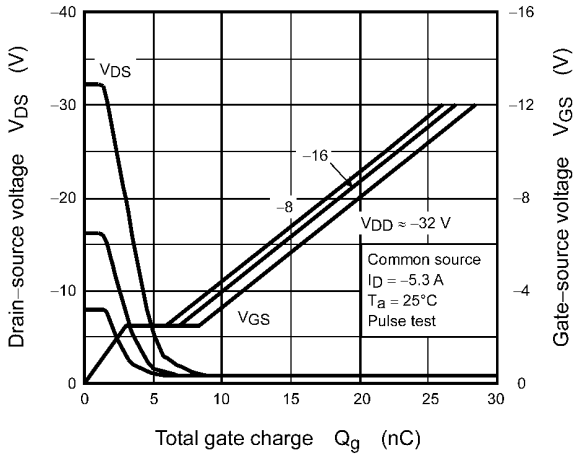


Fig. 8.1.10 Dynamic Input/Output Characteristics

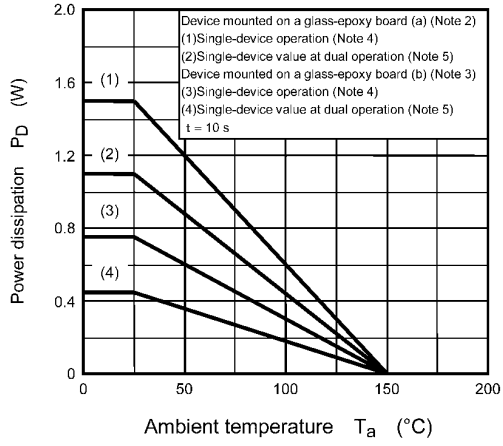


Fig. 8.1.11 P_D - T_a
(Guaranteed Maximum)

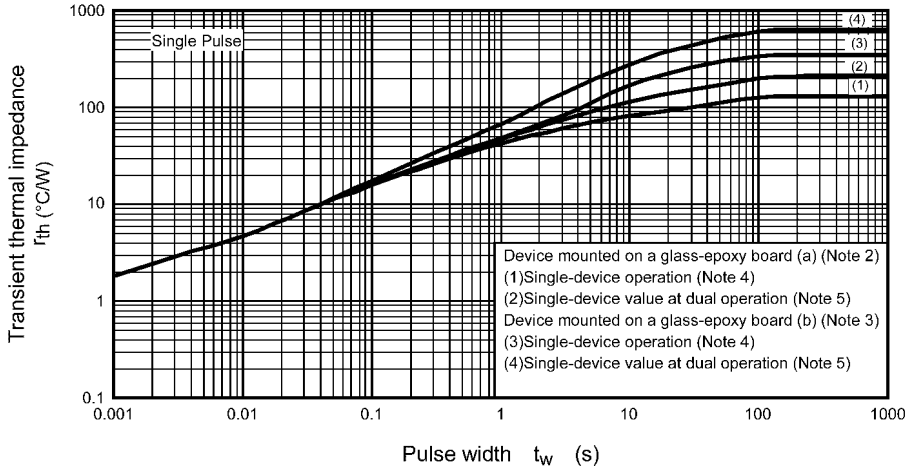


Fig. 8.1.12 r_{th} - t_w (Guaranteed Maximum)

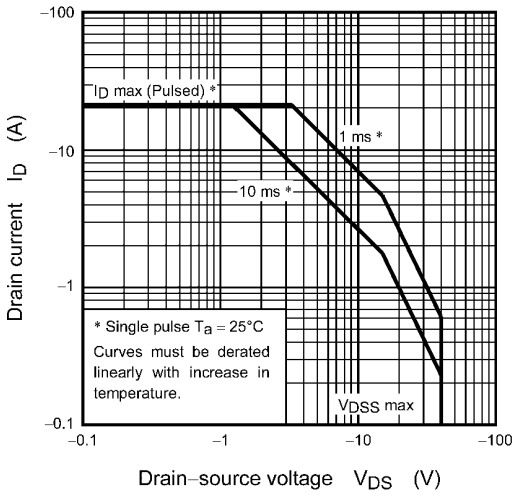


Fig. 8.1.13 Safe Operating Area (Guaranteed Maximum)

8.2. N-Channel MOSFET

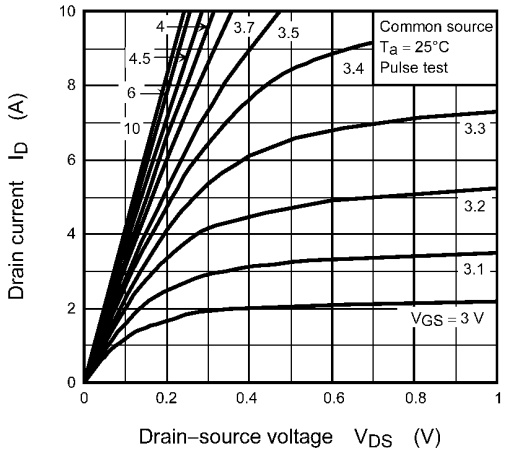


Fig. 8.2.1 I_D - V_{DS}

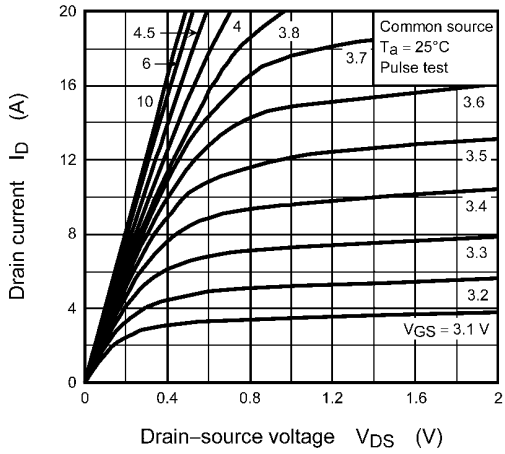


Fig. 8.2.2 I_D - V_{DS}

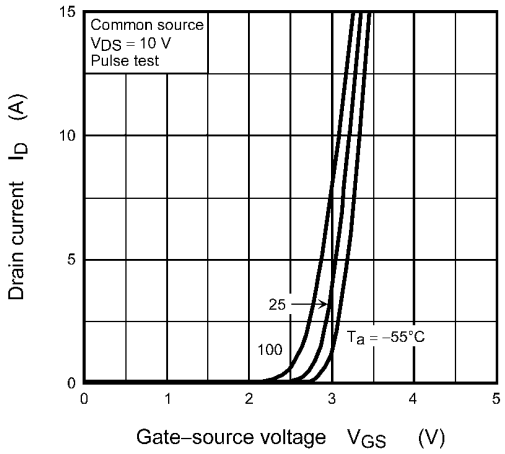


Fig. 8.2.3 I_D - V_{GS}

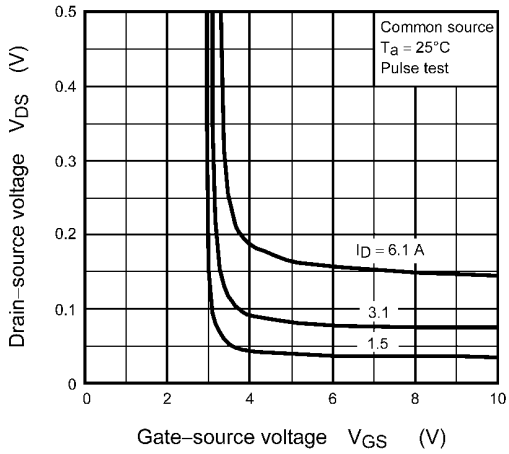


Fig. 8.2.4 V_{DS} - V_{GS}

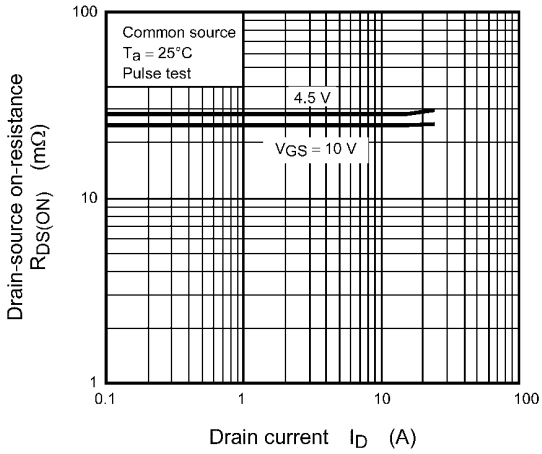


Fig. 8.2.5 $R_{DS(ON)}$ - I_D

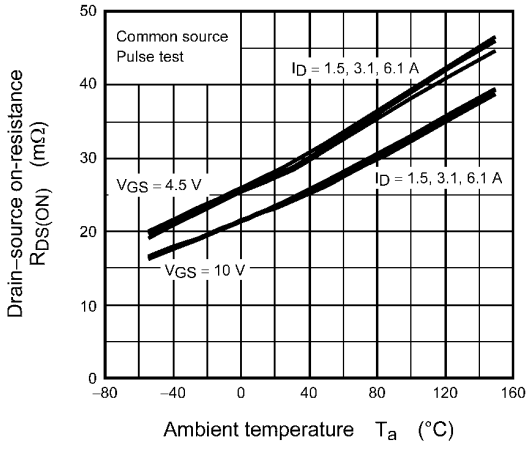


Fig. 8.2.6 $R_{DS(ON)}$ - T_a

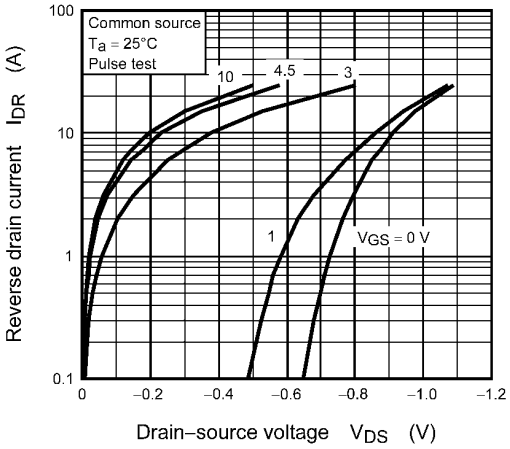


Fig. 8.2.7 I_{DR} - V_{DS}

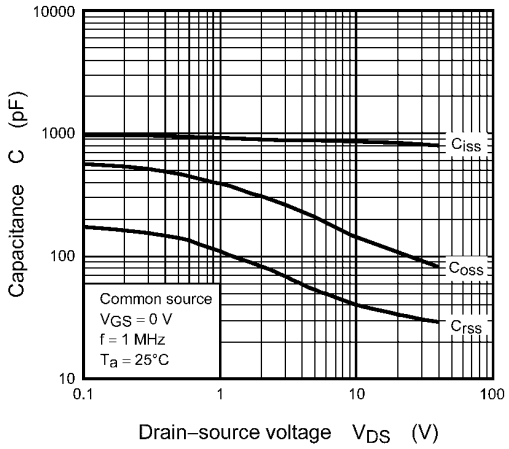


Fig. 8.2.8 Capacitance - V_{DS}

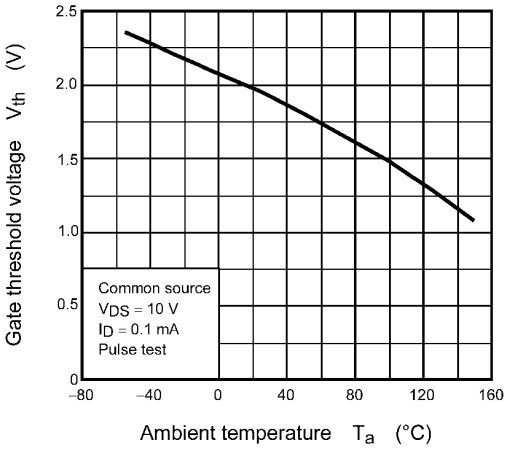


Fig. 8.2.9 V_{th} - T_a

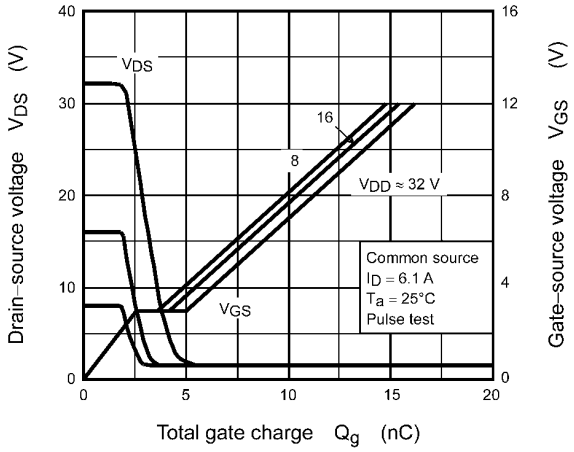


Fig. 8.2.10 Dynamic Input/Output Characteristics

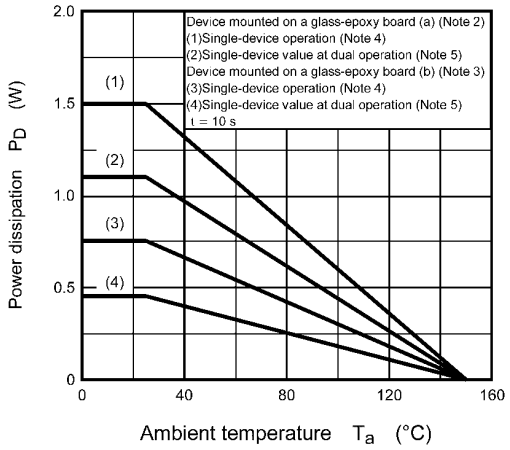


Fig. 8.2.11 P_D - T_a
(Guaranteed Maximum)

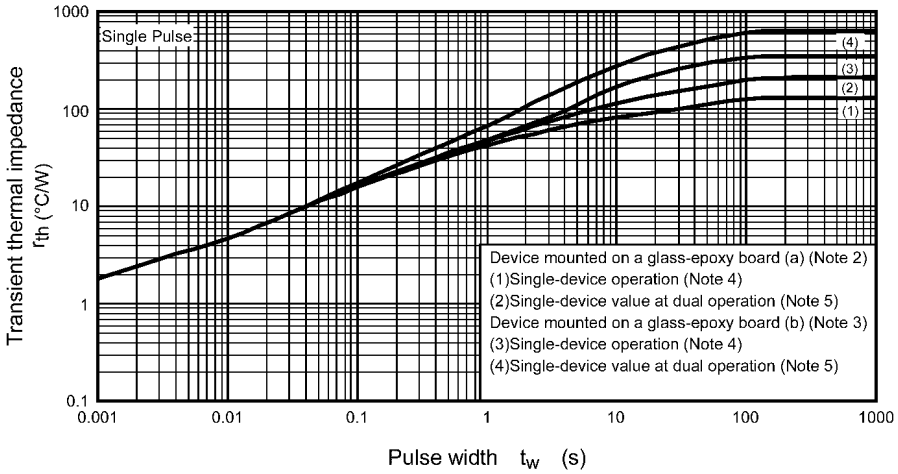


Fig. 8.2.12 r_{th} - t_w (Guaranteed Maximum)

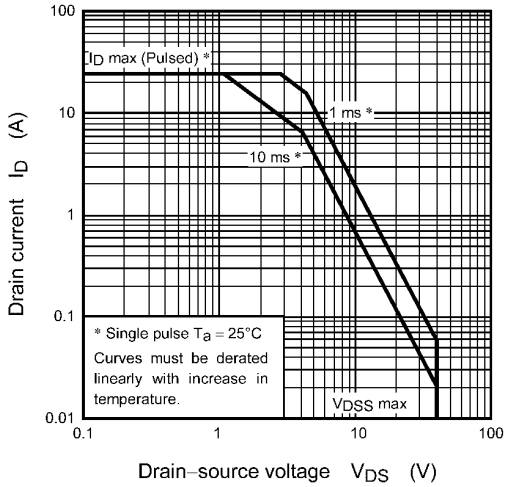
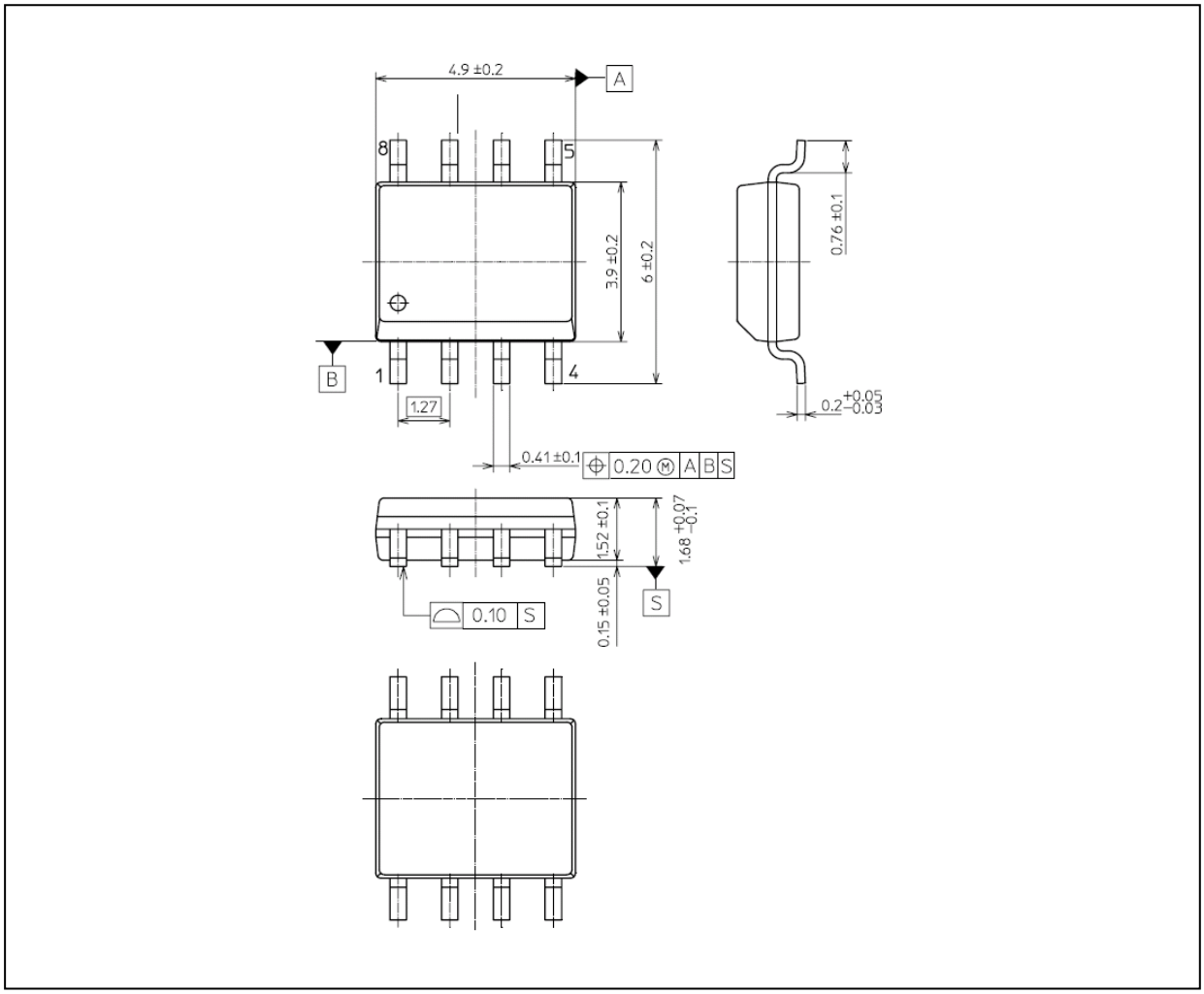


Fig. 8.2.13 Safe Operating Area (Guaranteed Maximum)

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

Package Dimensions

Unit: mm



Weight: 0.085 g (typ.)

Package Name(s)
TOSHIBA: 2-5R1S
Nickname: SOP-8

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