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

TPCP8406

1. Applications

- Cell Phones
- Motor Drivers

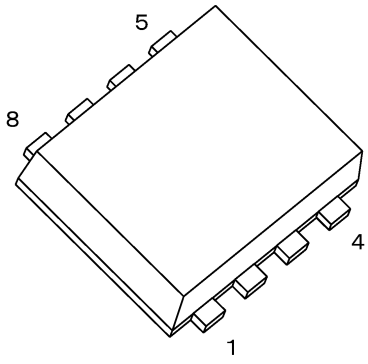
2. Features

(1) 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)

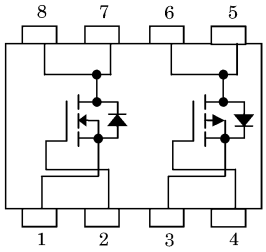
(2) Low leakage current
P-channel I_{DSS} = -10 μA (V_{DS} = -40 V),
N-channel I_{DSS} = 10 μA (V_{DS} = 40 V)

(3) 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



PS-8



1: Source 1
2: Gate 1
3: Source 2
4: Gate 2
5, 6: Drain 2
7, 8: Drain 1

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

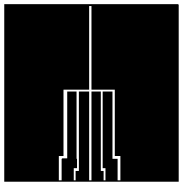
Characteristics			P/N	Symbol	Rating	Unit
Drain-source voltage			P-ch	V_{DSS}	-40	V
			N-ch		40	
Drain-gate voltage	(R_{GS} = 20 kΩ)		P-ch	V_{DGR}	-40	V
			N-ch		40	
Gate-source voltage			P-ch	V_{GSS}	±20	V
			N-ch		±20	
Drain current (DC)		(Note 1)	P-ch	I_D	-5	A
			N-ch		6	
Drain current (pulsed)		(Note 1)	P-ch	I_{DP}	-20	A
			N-ch		24	
Power dissipation (single operation)	(t = 5 s)	(Note 2), (Note 4)	P-ch	$P_{D(1)}$	1.48	W
			N-ch		1.48	
Power dissipation (per device for dual operation)	(t = 5 s)	(Note 2), (Note 5)	P-ch	$P_{D(2)}$	1.23	W
			N-ch		1.23	
Power dissipation (single operation)	(t = 5 s)	(Note 3), (Note 4)	P-ch	$P_{D(1)}$	0.58	W
			N-ch		0.58	
Power dissipation (per device for dual operation)	(t = 5 s)	(Note 3), (Note 5)	P-ch	$P_{D(2)}$	0.36	W
			N-ch		0.36	
Single-pulse avalanche energy		(Note 6)	P-ch	E_{AS}	6.5	mJ
			N-ch		9.36	
Avalanche current			P-ch	I_{AR}	-5	A
			N-ch		6	
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

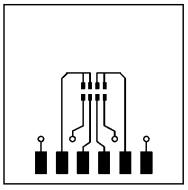
Characteristics			Symbol	Max	Unit
Channel-to-ambient thermal resistance (single operation)	(t = 5 s)	(Note 2), (Note 4)	$R_{th(ch-a)(1)}$	84.5	°C/W
Channel-to-ambient thermal resistance (per device for dual operation)	(t = 5 s)	(Note 2), (Note 5)	$R_{th(ch-a)(2)}$	101.6	
Channel-to-ambient thermal resistance (single operation)	(t = 5 s)	(Note 3), (Note 4)	$R_{th(ch-a)(1)}$	215.5	
Channel-to-ambient thermal resistance (per device for dual operation)	(t = 5 s)	(Note 3), (Note 5)	$R_{th(ch-a)(2)}$	347.2	

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 = 0.2 mH, R_G = 25 Ω, I_{AR} = -5 A
N channel: V_{DD} = 32 V, T_{ch} = 25°C (initial), L = 0.2 mH, R_G = 25 Ω, I_{AR} = 6 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

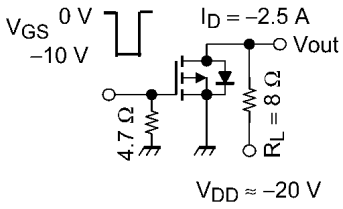
6.1. Static Characteristics (T_a = 25°C unless otherwise specified)

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 = -2.5 A	—	41	53.4	mΩ
			V_{GS} = -10 V, I_D = -2.5 A	—	33	43.2	
	N-ch		V_{GS} = 4.5 V, I_D = 3.0 A	—	28	36	
			V_{GS} = 10 V, I_D = 3.0 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.

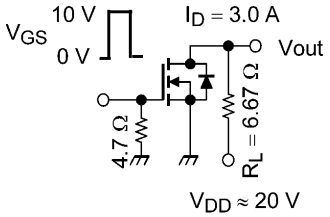
6.2. Dynamic Characteristics (T_a = 25°C unless otherwise specified)

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	—	133	—	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	—	166	—	pF
	N-ch		V_{DS} = 10 V, V_{GS} = 0 V, f = 1 MHz	—	142	—	
Switching time (rise time)	P-ch	t_r	See Figure 6.2.1.	—	8.0	—	ns
	N-ch		See Figure 6.2.2.	—	4.5	—	
Switching time (turn-on time)	P-ch	t_{on}	See Figure 6.2.1.	—	14.7	—	ns
	N-ch		See Figure 6.2.2.	—	11.5	—	
Switching time (fall time)	P-ch	t_f	See Figure 6.2.1.	—	32	—	ns
	N-ch		See Figure 6.2.2.	—	4.5	—	
Switching time (turn-off time)	P-ch	t_{off}	See Figure 6.2.1.	—	130	—	ns
	N-ch		See Figure 6.2.2.	—	24	—	



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 (T_a = 25°C unless otherwise specified)

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 A	—	24.2	—	nC
	N-ch		V_{DD} ≈ 32 V, V_{GS} = 10 V, I_D = 6 A	—	13.7	—	
Gate-source charge 1	P-ch	Q_{gs1}	V_{DD} ≈ -32 V, V_{GS} = -10 V, I_D = -5 A	—	3.0	—	nC
	N-ch		V_{DD} ≈ 32 V, V_{GS} = 10 V, I_D = 6 A	—	2.6	—	
Gate-drain charge	P-ch	Q_{gd}	V_{DD} ≈ -32 V, V_{GS} = -10 V, I_D = -5 A	—	5.3	—	nC
	N-ch		V_{DD} ≈ 32 V, V_{GS} = 10 V, I_D = 6 A	—	2.4	—	

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

Characteristics	P/N	Symbol	Test Condition	Min	Typ.	Max	Unit
Reverse drain current (pulsed) (Note 8)	P-ch	I_{DRP}	—	—	—	-20	A
	N-ch			—	—	24	
Diode forward voltage	P-ch	V_{DSF}	I_{DR} = -5 A, V_{GS} = 0 V	—	—	1.2	V
	N-ch		I_{DR} = 6 A, V_{GS} = 0 V	—	—	-1.2	

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

7. Marking

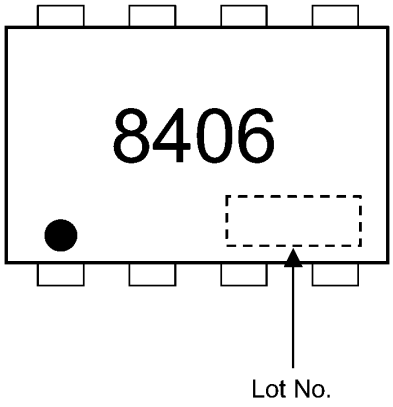


Fig. 7.1 Marking

8. Characteristics Curves (Note)

8.1. P-Channel MOSFET

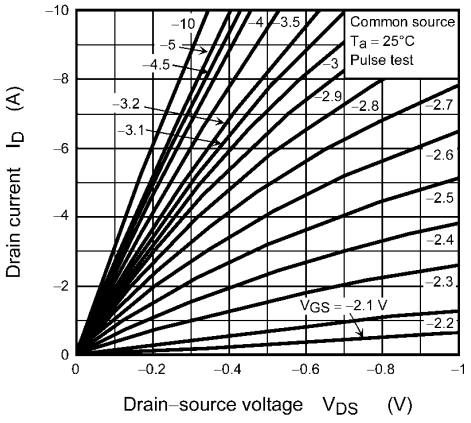


Fig. 8.1.1 I_D - V_{DS}

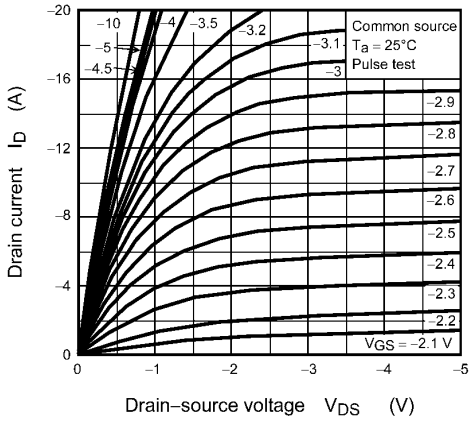


Fig. 8.1.2 I_D - V_{DS}

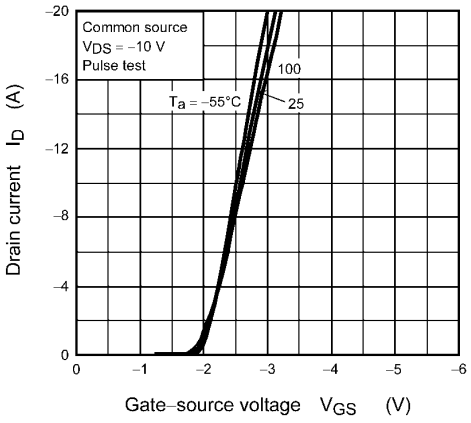


Fig. 8.1.3 I_D - V_{GS}

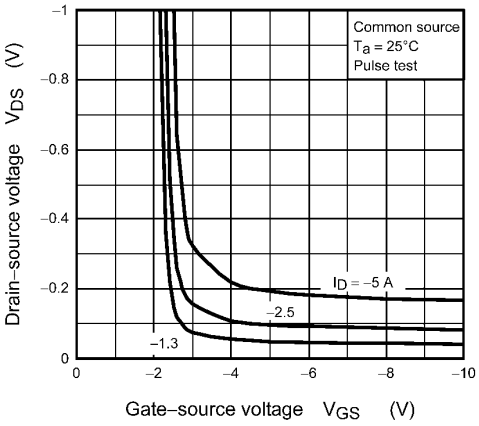


Fig. 8.1.4 V_{DS} - V_{GS}

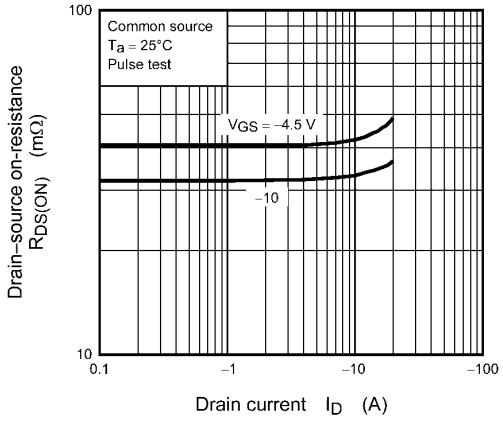


Fig. 8.1.5 $R_{DS(ON)}$ - I_D

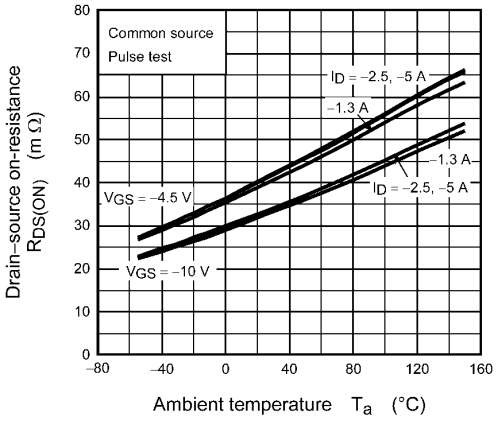


Fig. 8.1.6 $R_{DS(ON)}$ - T_a

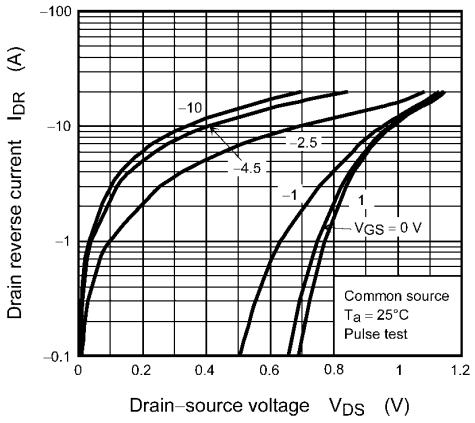


Fig. 8.1.7 I_{DR} - V_{DS}

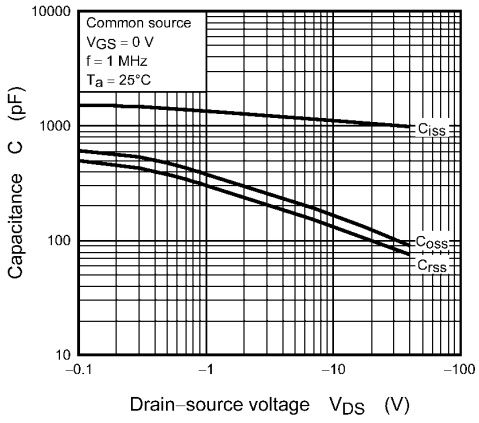


Fig. 8.1.8 Capacitance - V_{DS}

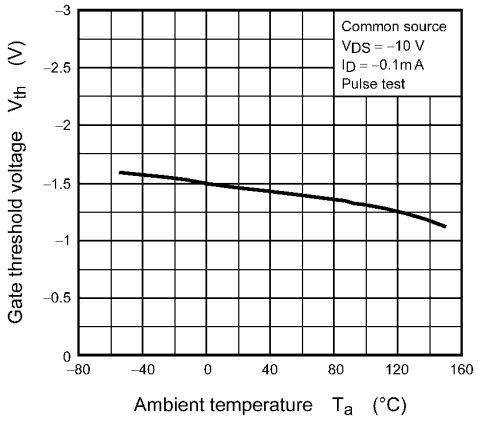


Fig. 8.1.9 V_{th} - T_a

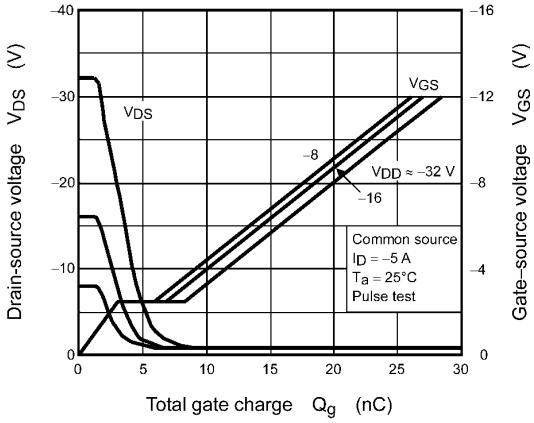


Fig. 8.1.10 Dynamic Input/Output Characteristics

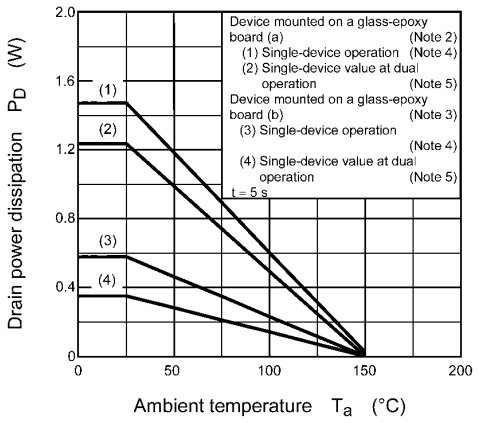


Fig. 8.1.11 P_D - T_a
(Guaranteed Maximum)

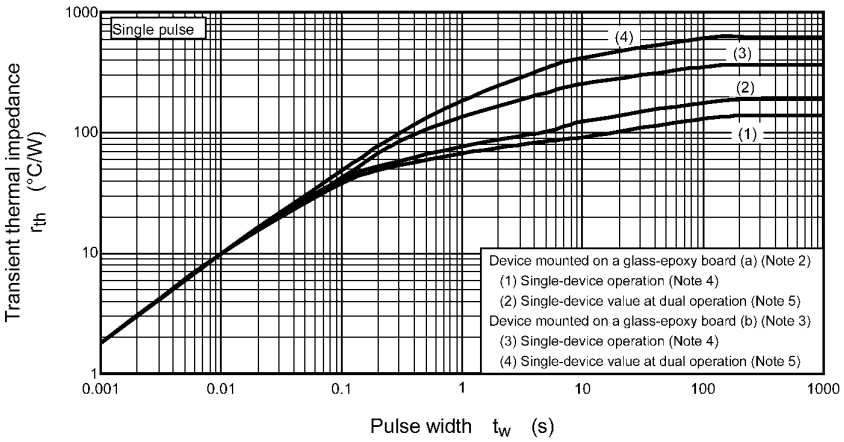


Fig. 8.1.12 r_{th} - t_w (Guaranteed Maximum)

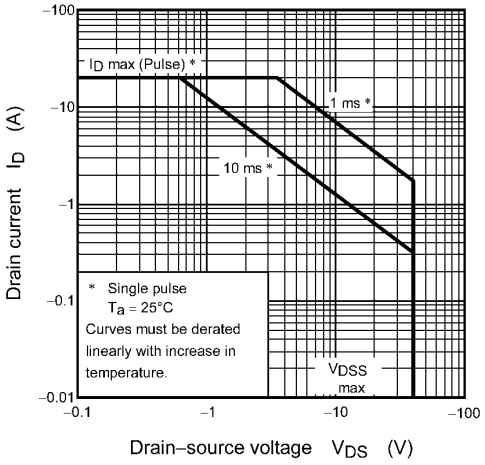


Fig. 8.1.13 Safe Operating Area (Guaranteed Maximum)

8.2. N-Channel MOSFET

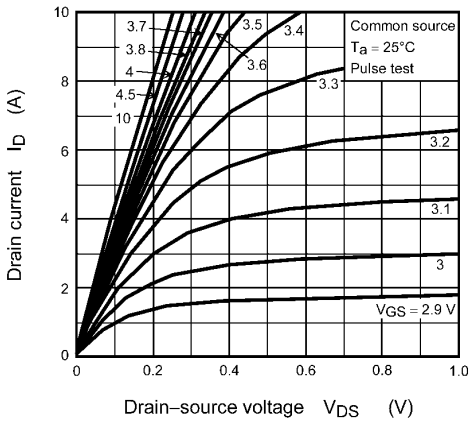


Fig. 8.2.1 I_D - V_{DS}

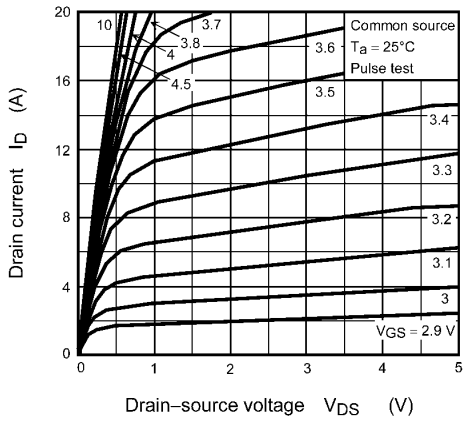


Fig. 8.2.2 I_D - V_{DS}

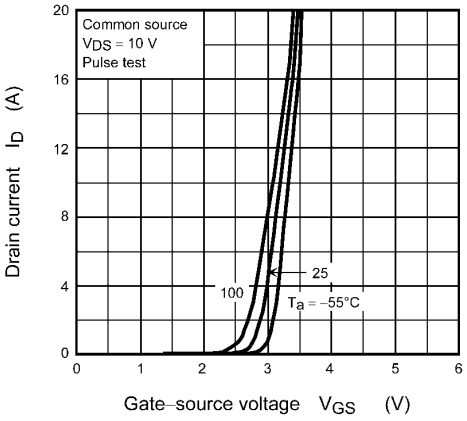


Fig. 8.2.3 I_D - V_{GS}

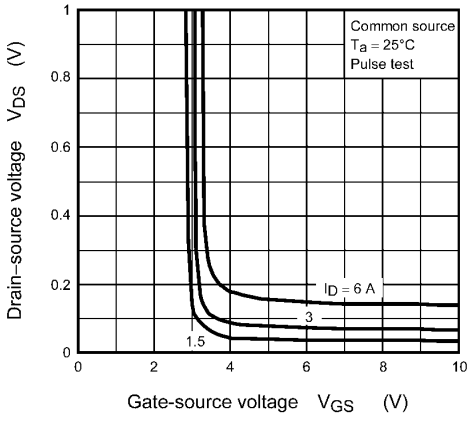


Fig. 8.2.4 V_{DS} - V_{GS}

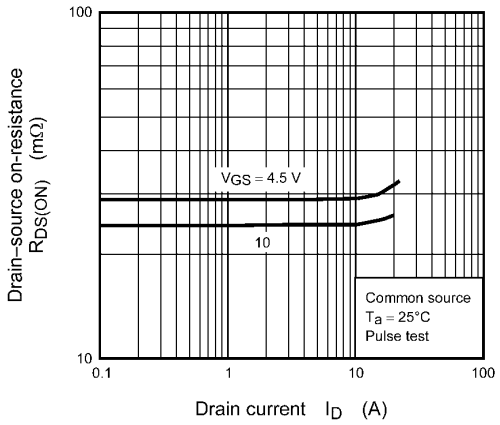


Fig. 8.2.5 $R_{DS(ON)}$ - I_D

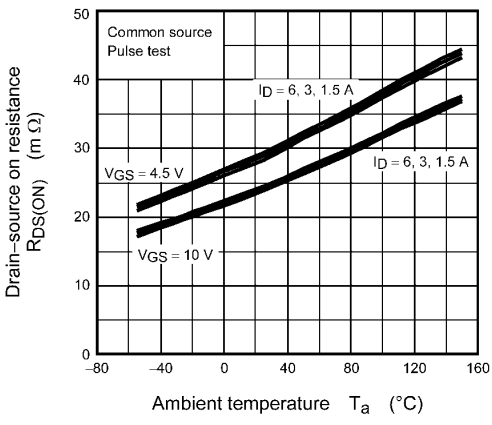


Fig. 8.2.6 $R_{DS(ON)}$ - T_a

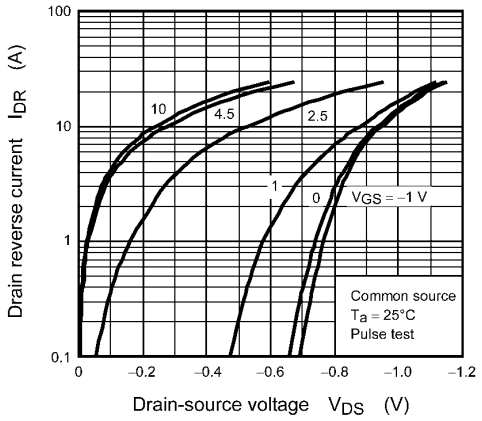


Fig. 8.2.7 I_{DR} - V_{DS}

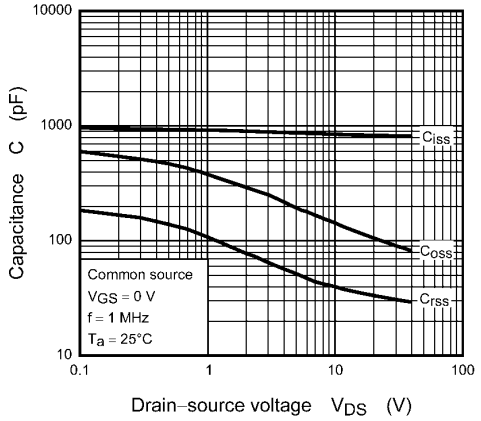


Fig. 8.2.8 Capacitance - V_{DS}

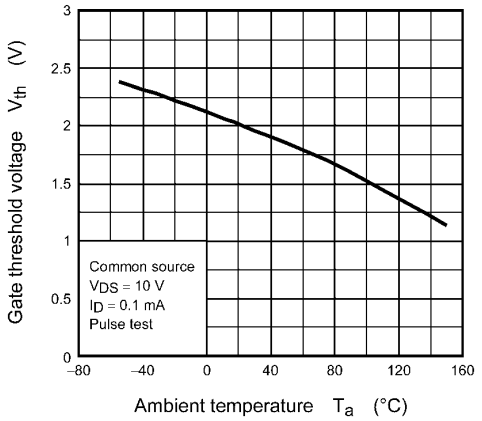


Fig. 8.2.9 V_{th} - T_a

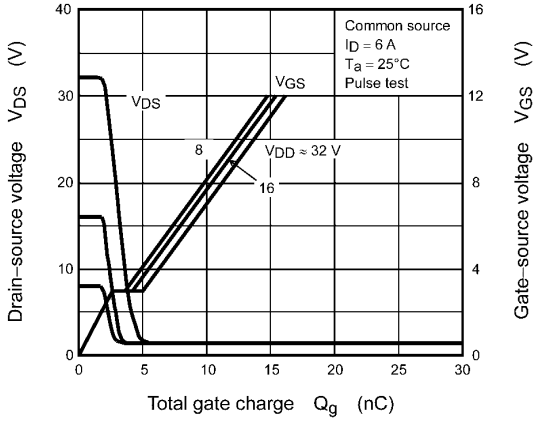


Fig. 8.2.10 Dynamic Input/Output Characteristics

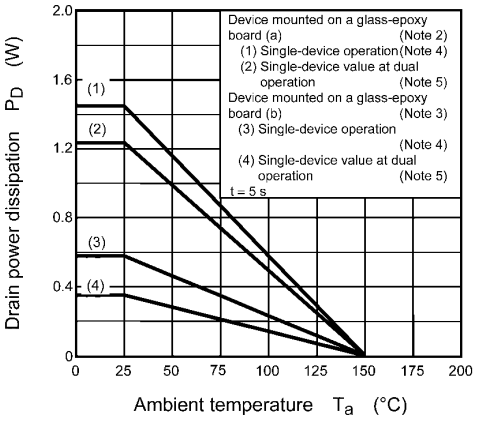


Fig. 8.2.11 P_D - T_a
(Guaranteed Maximum)

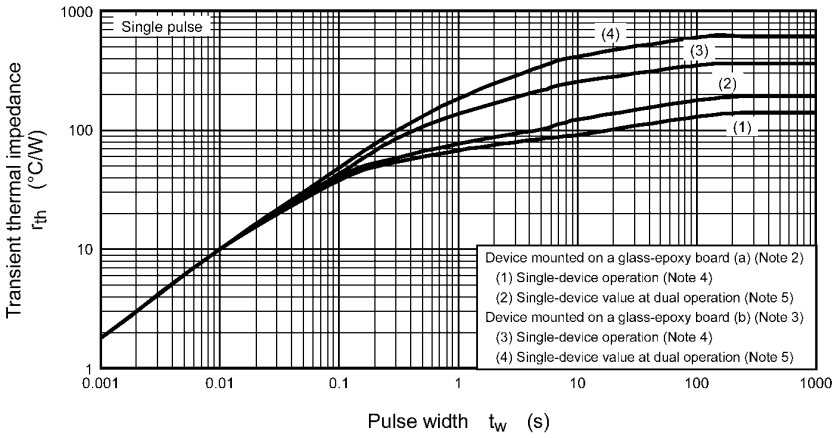


Fig. 8.2.12 r_{th} - t_w (Guaranteed Maximum)

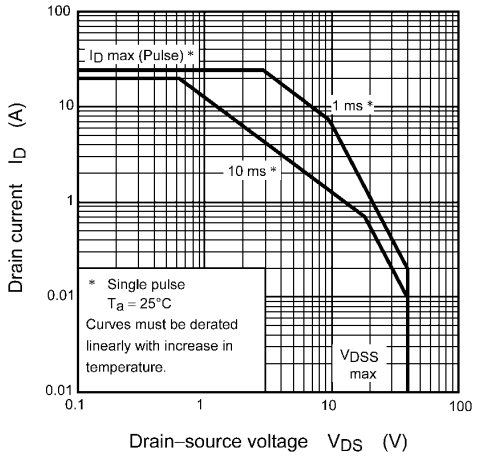
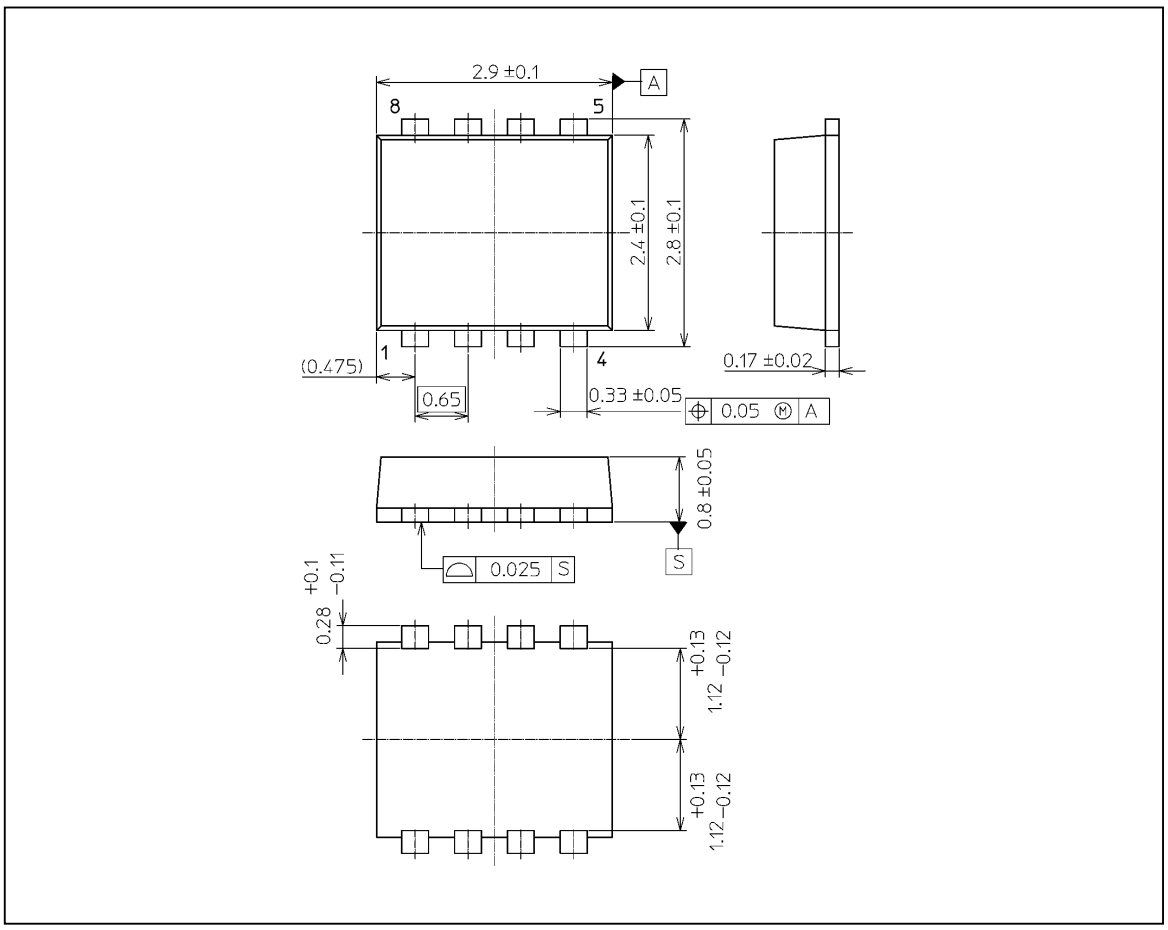


Fig. 8.2.13 Safe Operating Area (Guaranteed Maximum)

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

Package Dimensions

Unit: mm



Weight: 0.017 g (typ.)

Package Name(s)
TOSHIBA: 2-3V1S
Nickname: PS-8

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