

TPCA8121

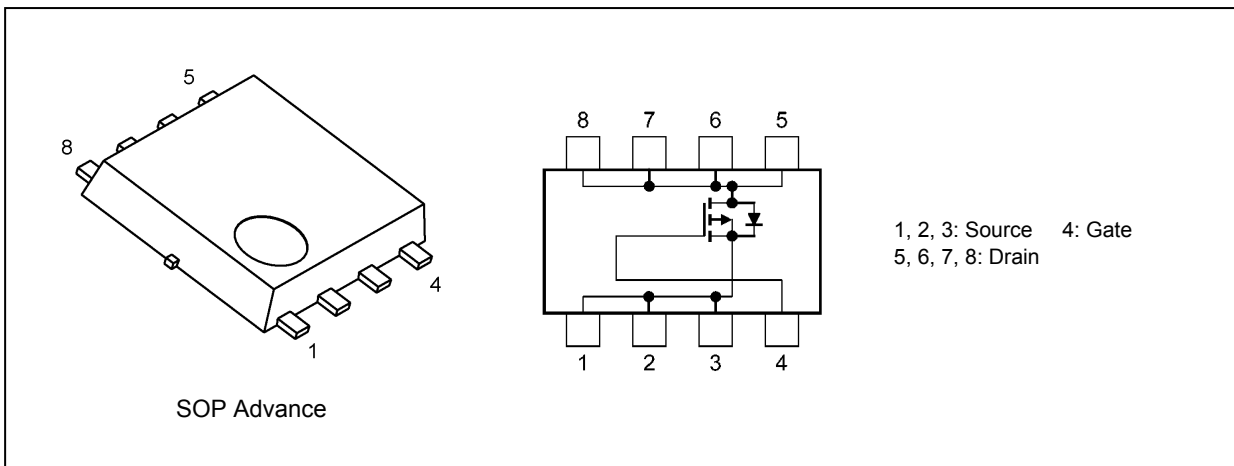
1. Applications

- Lithium-Ion Secondary Batteries
- Power Management Switches

2. Features

- (1) Small, thin package
- (2) Low drain-source on-resistance: $R_{DS(ON)} = 2.4 \text{ m}\Omega$ (typ.) ($V_{GS} = -10 \text{ V}$)
- (3) Low leakage current: $I_{DSS} = -10 \text{ }\mu\text{A}$ (max) ($V_{DS} = -30 \text{ V}$)
- (4) Enhancement mode: $V_{th} = -0.8$ to -2.0 V ($V_{DS} = -10 \text{ V}$, $I_D = -1 \text{ mA}$)

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}	-30	V
Drain-gate voltage ($R_{GS} = 20 \text{ k}\Omega$)	V_{DGR}	-30	
Gate-source voltage	V_{GSS}	-20/+10	
Drain current (DC)	I_D	-45	A
Drain current (pulsed)	I_{DP}	-135	
Power dissipation ($T_c = 25^\circ\text{C}$)	P_D	45	W
Power dissipation ($t = 10 \text{ s}$)	P_D	2.8	
Power dissipation ($t = 10 \text{ s}$)	P_D	1.6	
Single-pulse avalanche energy	E_{AS}	263	mJ
Avalanche current	I_{AR}	-45	A
Channel temperature	T_{ch}	175	$^\circ\text{C}$
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).

5. Thermal Characteristics

Characteristics	Symbol	Max	Unit
Channel-to-case thermal resistance (T _c = 25°C)	R _{th(ch-c)}	2.78	°C/W
Channel-to-ambient thermal resistance (t = 10 s) (Note 2)	R _{th(ch-a)}	44.6	°C/W
Channel-to-ambient thermal resistance (t = 10 s) (Note 3)	R _{th(ch-a)}	78.1	°C/W

Note 1: Ensure that the channel temperature does not exceed 175°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: V_{DD} = -24 V, T_{ch} = 25°C (initial), L = 100 μH, R_G = 25 Ω, I_{AR} = -45 A

Note 5: Merely Channel temperature is guaranteed 175°C.

Storage temperature range is guaranteed as usual (-55 to 150°C).

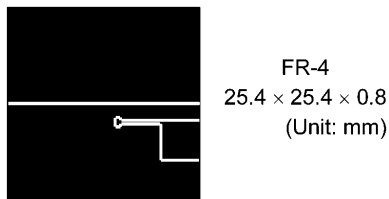


Fig. 5.1 Device Mounted on a Glass-Epoxy Board (a)

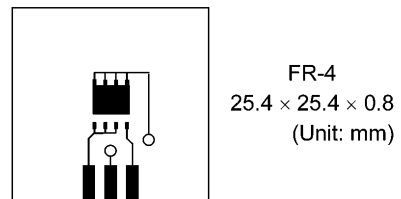


Fig. 5.2 Device Mounted on a Glass-Epoxy Board (b)

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

6. Electrical Characteristics

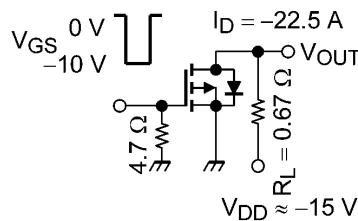
6.1. Static Characteristics ($T_a = 25^\circ\text{C}$ unless otherwise specified)

Characteristics	Symbol	Test Condition	Min	Typ.	Max	Unit
Gate leakage current	I_{GSS}	$V_{GS} = -20/+10\text{ V}, V_{DS} = 0\text{ V}$	—	—	± 100	nA
Drain cut-off current	I_{DSS}	$V_{DS} = -30\text{ V}, V_{GS} = 0\text{ V}$	—	—	-10	μA
Drain-source breakdown voltage	$V_{(BR)DSS}$	$I_D = -10\text{ mA}, V_{GS} = 0\text{ V}$	-30	—	—	V
Drain-source breakdown voltage (Note 6)	$V_{(BR)DSX}$	$I_D = -10\text{ mA}, V_{GS} = 10\text{ V}$	-21	—	—	
Gate threshold voltage	V_{th}	$V_{DS} = -10\text{ V}, I_D = -1\text{ mA}$	-0.8	—	-2.0	
Drain-source on-resistance	$R_{DS(ON)}$	$V_{GS} = -4.5\text{ V}, I_D = -22.5\text{ A}$	—	3.1	4.0	m Ω
		$V_{GS} = -10\text{ V}, I_D = -22.5\text{ A}$	—	2.4	3.0	

Note 6: 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 ($T_a = 25^\circ\text{C}$ unless otherwise specified)

Characteristics	Symbol	Test Condition	Min	Typ.	Max	Unit
Input capacitance	C_{iss}	$V_{DS} = -10\text{ V}, V_{GS} = 0\text{ V}, f = 1\text{ MHz}$	—	7420	—	pF
Reverse transfer capacitance	C_{riss}		—	1180	—	
Output capacitance	C_{oss}		—	1440	—	
Switching time (rise time)	t_r	See Figure 6.2.1.	—	10	—	ns
Switching time (turn-on time)	t_{on}		—	18	—	
Switching time (fall time)	t_f		—	262	—	
Switching time (turn-off time)	t_{off}		—	762	—	



Duty $\leq 1\%$, $t_w = 10\ \mu\text{s}$

Fig. 6.2.1 Switching Time Test Circuit

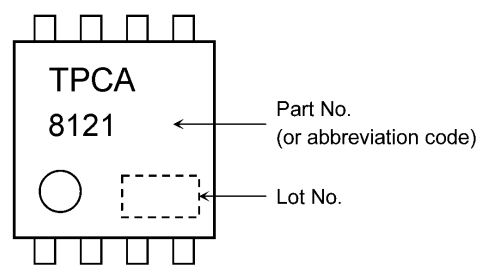
6.3. Gate Charge Characteristics ($T_a = 25^\circ\text{C}$ unless otherwise specified)

Characteristics	Symbol	Test Condition	Min	Typ.	Max	Unit
Total gate charge (gate-source plus gate-drain)	Q_g	$V_{DD} \approx -24\text{ V}, V_{GS} = -10\text{ V}, I_D = -45\text{ A}$	—	190	—	nC
Gate-source charge 1	Q_{gs1}		—	23	—	
Gate-drain charge	Q_{gd}		—	47	—	

6.4. Source-Drain Characteristics ($T_a = 25^\circ\text{C}$ unless otherwise specified)

Characteristics	Symbol	Test Condition	Min	Typ.	Max	Unit
Reverse drain current (pulsed) (Note 7)	I_{DRP}	—	—	—	-135	A
Diode forward voltage	V_{DSF}	$I_{DR} = -45\text{ A}, V_{GS} = 0\text{ V}$	—	—	1.2	V

Note 7: Ensure that the channel temperature does not exceed 175°C .

7. Marking**Fig. 7.1 Marking**

8. Characteristics Curves (Note)

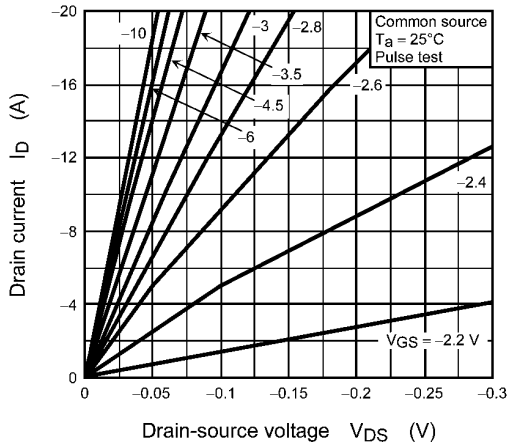


Fig. 8.1 $I_D - V_{DS}$

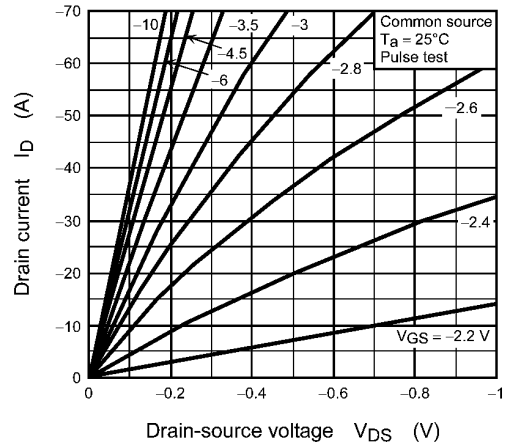


Fig. 8.2 $I_D - V_{DS}$

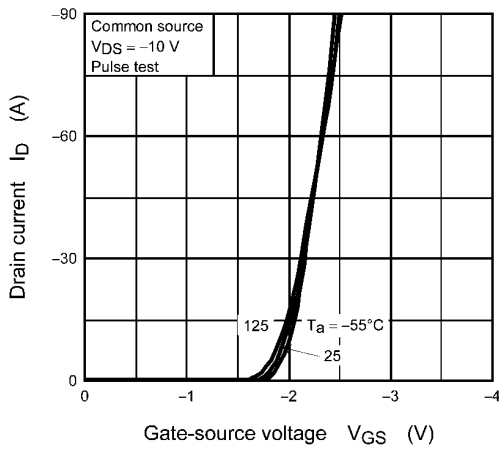


Fig. 8.3 $I_D - V_{GS}$

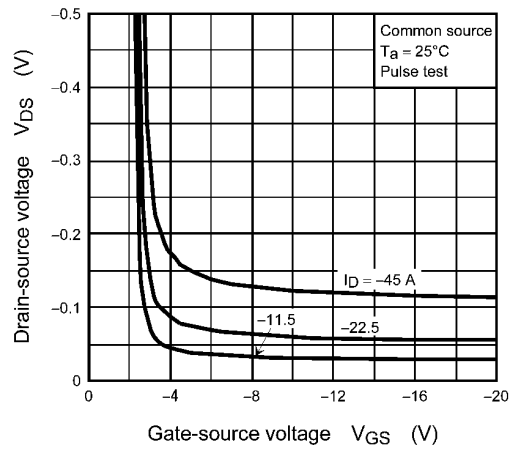


Fig. 8.4 $V_{DS} - V_{GS}$

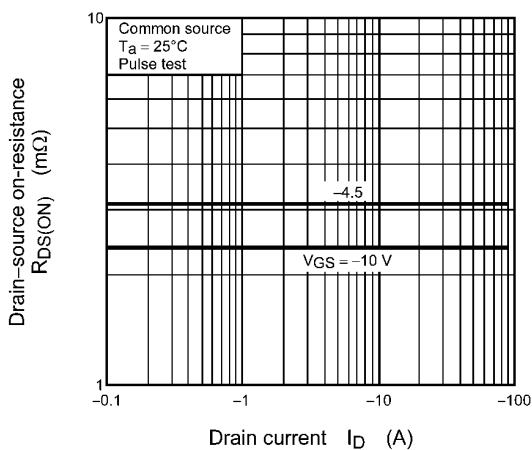


Fig. 8.5 $R_{DS(ON)} - I_D$

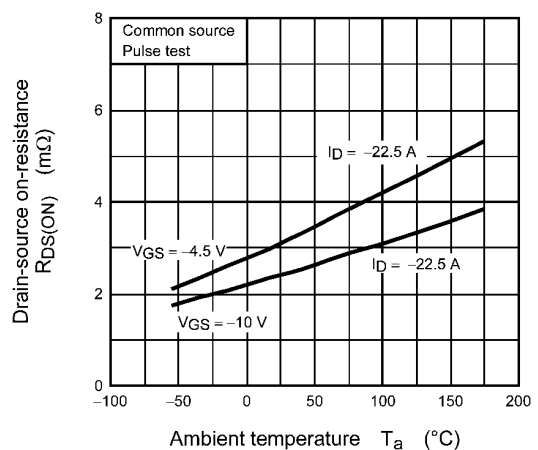


Fig. 8.6 $R_{DS(ON)} - T_a$

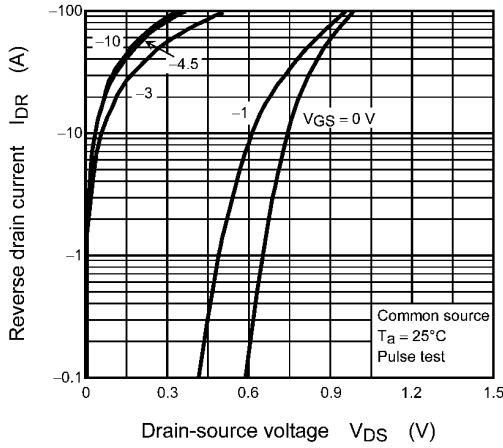


Fig. 8.7 $I_{DR} - V_{DS}$

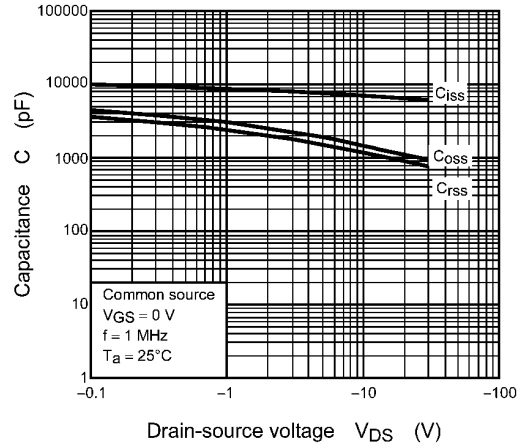


Fig. 8.8 Capacitance - V_{DS}

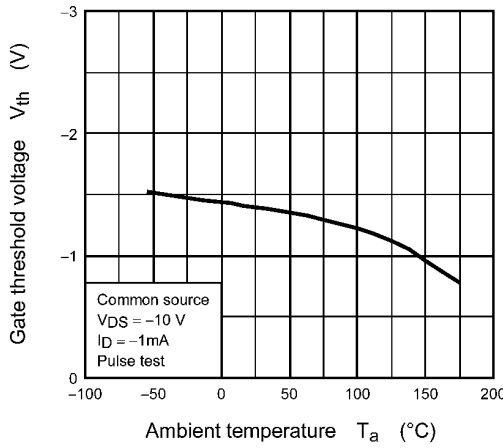


Fig. 8.9 $V_{th} - T_a$

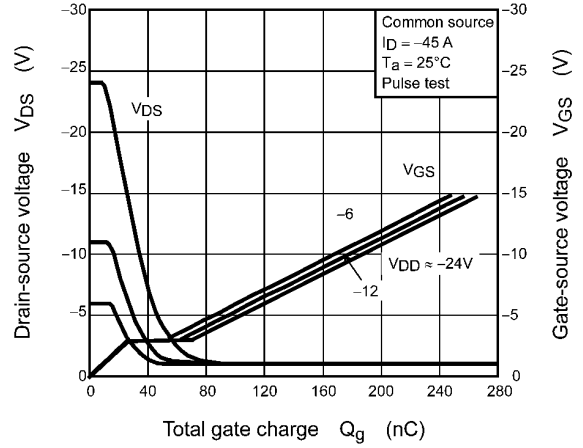
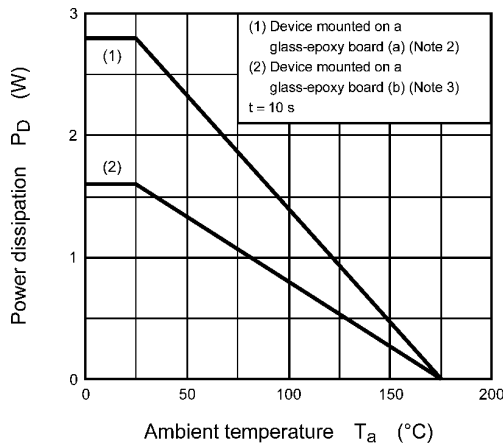
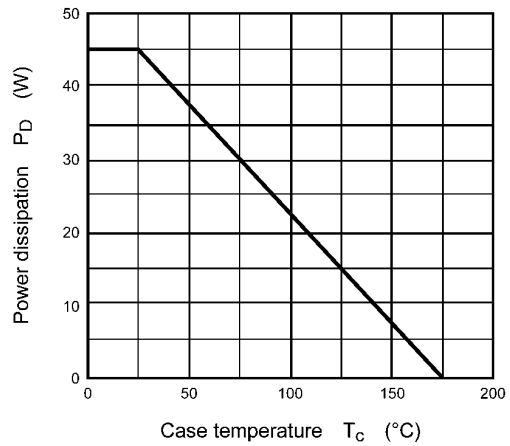


Fig. 8.10 Dynamic Input/Output Characteristics



**Fig. 8.11 $P_D - T_a$
(Guaranteed Maximum)**



**Fig. 8.12 $P_D - T_c$
(Guaranteed Maximum)**

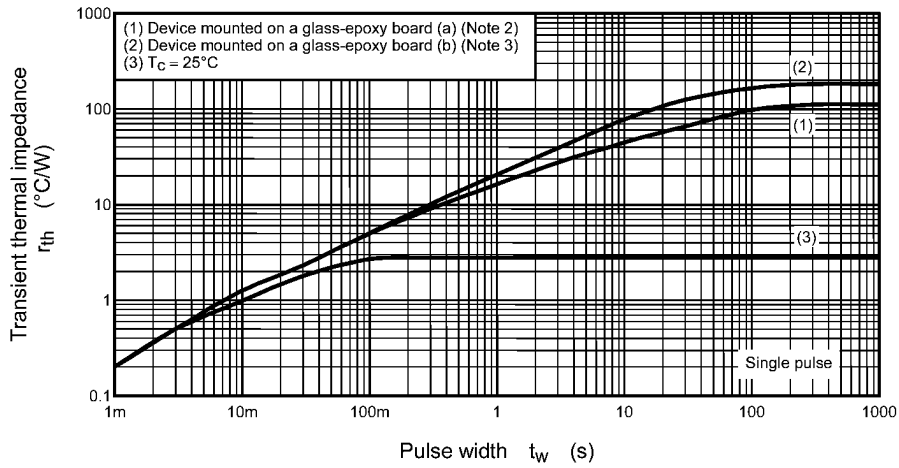


Fig. 8.13 $r_{th} - t_w$
(Guaranteed Maximum)

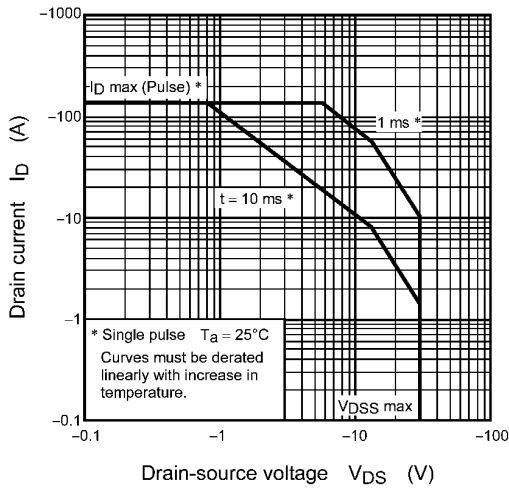


Fig. 8.14 Safe Operating Area
(Guaranteed Maximum)

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

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