

TOSHIBA Field Effect Transistor Silicon P, N Channel MOS Type (U-MOS IV / U-MOS III)

# TPCF8402

Portable Equipment Applications  
 Motor Drive Applications  
 DC-DC Converter Applications

Unit: mm

- Low drain-source ON resistance : P Channel  $R_{DS(ON)} = 60 \text{ m}\Omega$  (typ.)  
 N Channel  $R_{DS(ON)} = 38 \text{ m}\Omega$  (typ.)
- High forward transfer admittance : P Channel  $|Y_{fs}| = 5.9 \text{ S}$  (typ.)  
 N Channel  $|Y_{fs}| = 6.8 \text{ S}$  (typ.)
- Low leakage current : P Channel  $I_{DSS} = -10 \text{ }\mu\text{A}$  ( $V_{DS} = -30 \text{ V}$ )  
 N Channel  $I_{DSS} = 10 \text{ }\mu\text{A}$  ( $V_{DS} = 30 \text{ V}$ )
- Enhancement-mode  
 : P Channel  $V_{th} = -0.8 \text{ to } -2.0 \text{ V}$  ( $V_{DS} = -10 \text{ V}$ ,  $I_D = -1\text{mA}$ )  
 N Channel  $V_{th} = 1.3 \text{ to } 2.5 \text{ V}$  ( $V_{DS} = 10 \text{ V}$ ,  $I_D = 1\text{mA}$ )

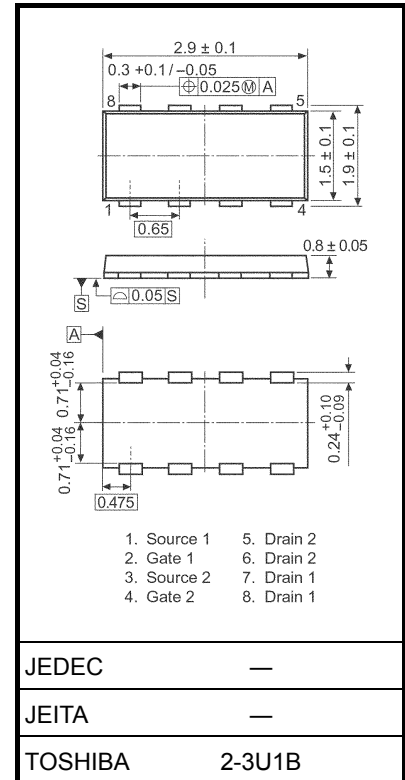
## Absolute Maximum Ratings ( $T_a = 25^\circ\text{C}$ )

Characteristics		Symbol	Rating		Unit
Drain-source voltage		$V_{DSS}$	-30	30	V
Drain-gate voltage ( $R_{GS} = 20 \text{ k}\Omega$ )		$V_{DGR}$	-30	30	V
Gate-source voltage		$V_{GSS}$	$\pm 20$	$\pm 20$	V
Drain current	DC (Note 1)	$I_D$	-3.2	4.0	A
	Pulse (Note 1)	$I_{DP}$	-12.8	16.0	
Drain power dissipation ( $t = 5 \text{ s}$ ) (Note 2a)	Single-device operation (Note 3a)	$P_D(1)$	1.35	1.35	W
	Single-device value at dual operation (Note 3b)	$P_D(2)$	1.12	1.12	
Drain power dissipation ( $t = 5 \text{ s}$ ) (Note 2b)	Single-device operation (Note 3a)	$P_D(1)$	0.53	0.53	W
	Single-device value at dual operation (Note 3b)	$P_D(2)$	0.33	0.33	
Single pulse avalanche energy (Note 4)		$E_{AS}$	0.67	2.6	mJ
Avalanche current		$I_{AR}$	-1.6	2.0	A
Repetitive avalanche energy Single-device value at dual operation (Note 2a, 3b, 5)		$E_{AR}$	0.11		mJ
Channel temperature		$T_{ch}$	150		$^\circ\text{C}$
Storage temperature range		$T_{stg}$	-55 to 150		$^\circ\text{C}$

Note: For Notes 1 to 5, refer to the next page.

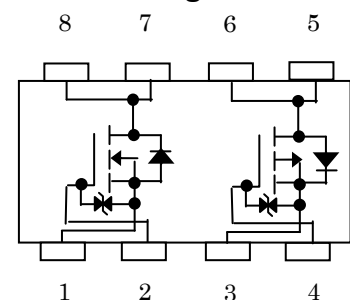
Using continuously under heavy loads (e.g. the application of high temperature/current/voltage and the significant change in temperature, etc.) may cause this product to decrease in the reliability significantly even if the operating conditions (i.e. operating temperature/current/voltage, etc.) are within 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).

This transistor is an electrostatic-sensitive device. Handle with caution.



Weight: 0.011 g (typ.)

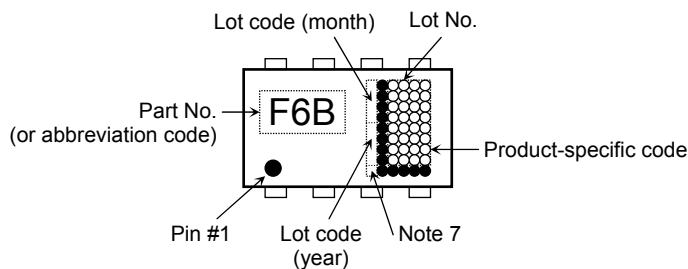
## Circuit Configuration



## Thermal Characteristics

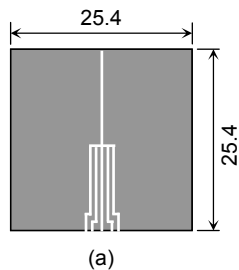
Characteristics		Symbol	Max	Unit
Thermal resistance, channel to ambient (t = 5 s) (Note 2a)	Single-device operation (Note 3a)	R <sub>th (ch-a)</sub> (1)	92.6	°C/W
	Single-device value at dual operation (Note 3b)	R <sub>th (ch-a)</sub> (2)	111.6	
Thermal resistance, channel to ambient (t = 5 s) (Note 2b)	Single-device operation (Note 3a)	R <sub>th (ch-a)</sub> (1)	235.8	°C/W
	Single-device value at dual operation (Note 3b)	R <sub>th (ch-a)</sub> (2)	378.8	

## Marking (Note 6)

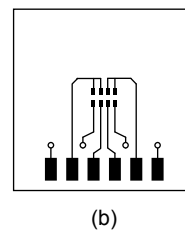


Note 1: Ensure that the channel temperature does not exceed 150°C.

Note 2: (a) Device mounted on a glass-epoxy board (a) (b) Device mounted on a glass-epoxy board (b)



FR-4  
25.4 × 25.4 × 0.8  
(Unit: mm)



FR-4  
25.4 × 25.4 × 0.8  
(Unit: mm)

Note 3: a) The power dissipation and thermal resistance values are shown for a single device. (During single-device operation, power is only applied to one device.)

b) The power dissipation and thermal resistance values are shown for a single device. (During dual operation, power is evenly applied to both devices.)

Note 4: P Channel: V<sub>DD</sub> = -24 V, T<sub>ch</sub> = 25°C (initial), L = 0.2 mH, R<sub>G</sub> = 25 Ω, I<sub>AR</sub> = -1.6 A  
N Channel: V<sub>DD</sub> = 24 V, T<sub>ch</sub> = 25°C (initial), L = 0.5 mH, R<sub>G</sub> = 25 Ω, I<sub>AR</sub> = 2.0 A

Note 5: Repetitive rating: Pulse width limited by maximum channel temperature.

Note 6: “●” on the lower left of the marking indicates Pin 1.

Note 7 A dot marking identifies the indication of product Labels.  
Without a dot: [[Pb]]/INCLUDES > MCV  
With a dot: [[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.

## P-channel

### Electrical Characteristics (Ta = 25°C)

Characteristics		Symbol	Test Condition	Min	Typ.	Max	Unit
Gate leakage current		$I_{GSS}$	$V_{GS} = \pm 16 \text{ V}, V_{DS} = 0 \text{ V}$	—	—	$\pm 10$	$\mu\text{A}$
Drain cut-off current		$I_{DSS}$	$V_{DS} = -30 \text{ V}, V_{GS} = 0 \text{ V}$	—	—	-10	$\mu\text{A}$
Drain-source breakdown voltage		$V_{(BR)DSS}$	$I_D = -10 \text{ mA}, V_{GS} = 0 \text{ V}$	-30	—	—	V
		$V_{(BR)DSX}$	$I_D = -10 \text{ mA}, V_{GS} = 20 \text{ V}$	-15	—	—	
Gate threshold voltage		$V_{th}$	$V_{DS} = -10 \text{ V}, I_D = -1 \text{ mA}$	-0.8	—	-2.0	V
Drain-source ON resistance		$R_{DS(ON)}$	$V_{GS} = -4.5 \text{ V}, I_D = -1.6 \text{ A}$	—	80	105	m $\Omega$
			$V_{GS} = -10 \text{ V}, I_D = -1.6 \text{ A}$	—	60	72	
Forward transfer admittance		$ Y_{fs} $	$V_{DS} = -10 \text{ V}, I_D = -1.6 \text{ A}$	2.9	5.9	—	S
Input capacitance		$C_{iss}$	$V_{DS} = -10 \text{ V}, V_{GS} = 0 \text{ V}, f = 1 \text{ MHz}$	—	600	—	pF
Reverse transfer capacitance		$C_{rss}$		—	60	—	
Output capacitance		$C_{oss}$		—	70	—	
Switching time	Rise time	$t_r$		—	5.3	—	ns
	Turn-on time	$t_{on}$		—	12	—	
	Fall time	$t_f$		—	8.4	—	
	Turn-off time	$t_{off}$		—	34	—	
Total gate charge (gate-source plus gate-drain)		$Q_g$	$V_{DD} \approx -24 \text{ V}, V_{GS} = -10 \text{ V}, I_D = -3.2 \text{ A}$	—	14	—	nC
Gate-source charge 1		$Q_{gs1}$		—	1.4	—	
Gate-drain ("miller") charge		$Q_{gd}$		—	2.7	—	

### Source-Drain Ratings and Characteristics (Ta = 25°C)

Characteristics		Symbol	Test Condition	Min	Typ.	Max	Unit
Drain reverse current	Pulse (Note 1)	$I_{DRP}$	—	—	—	-12.8	A
Forward voltage (diode)		$V_{DSF}$	$I_{DR} = -3.2 \text{ A}, V_{GS} = 0 \text{ V}$	—	—	1.2	V

## N-channel

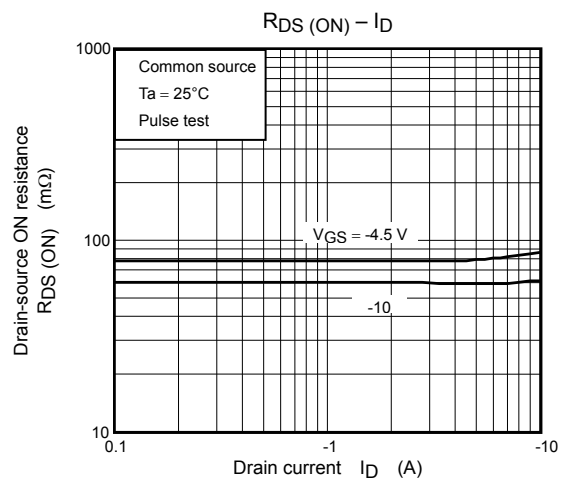
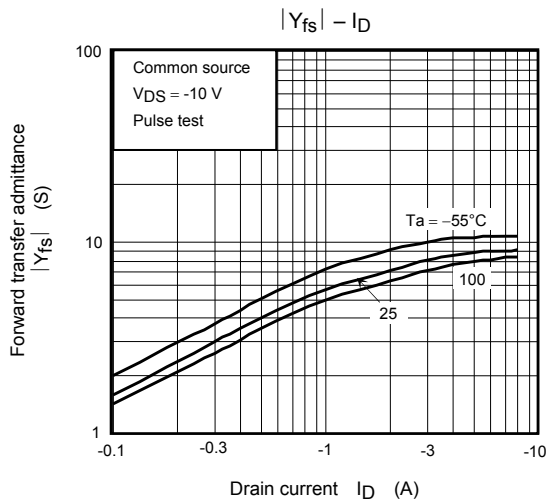
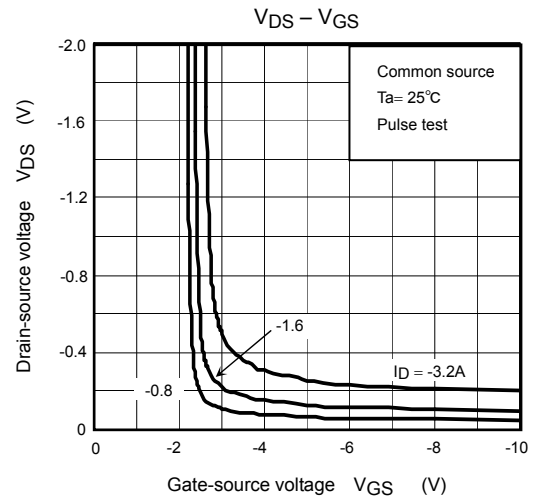
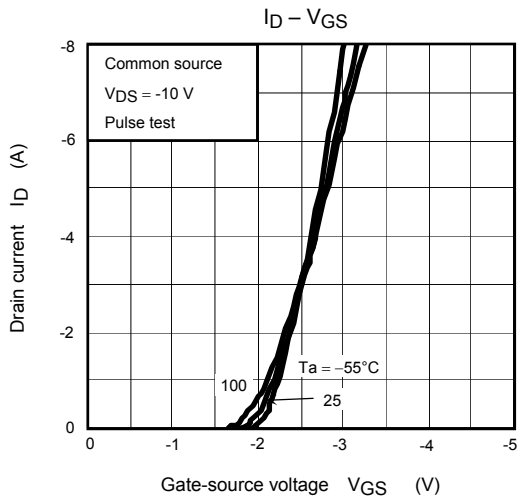
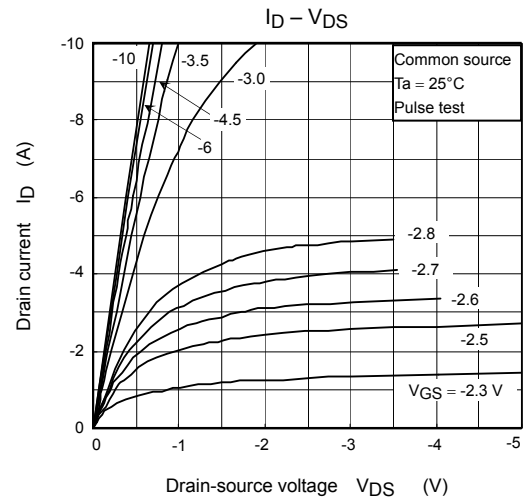
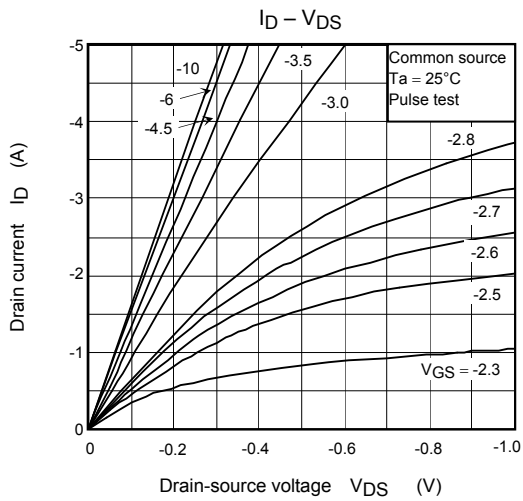
### Electrical Characteristics (Ta = 25°C)

Characteristics		Symbol	Test Condition	Min	Typ.	Max	Unit
Gate leakage current		$I_{GSS}$	$V_{GS} = \pm 16 \text{ V}, V_{DS} = 0 \text{ V}$	—	—	$\pm 10$	$\mu\text{A}$
Drain cut-off current		$I_{DSS}$	$V_{DS} = 30 \text{ V}, V_{GS} = 0 \text{ V}$	—	—	10	$\mu\text{A}$
Drain-source breakdown voltage		$V_{(BR)DSS}$	$I_D = 10 \text{ mA}, V_{GS} = 0 \text{ V}$	30	—	—	V
		$V_{(BR)DSX}$	$I_D = 10 \text{ mA}, V_{GS} = -20 \text{ V}$	15	—	—	
Gate threshold voltage		$V_{th}$	$V_{DS} = 10 \text{ V}, I_D = 1 \text{ mA}$	1.3	—	2.5	V
Drain-source ON resistance		$R_{DS(ON)}$	$V_{GS} = 4.5 \text{ V}, I_D = 2.0 \text{ A}$	—	58	77	m $\Omega$
			$V_{GS} = 10 \text{ V}, I_D = 2.0 \text{ A}$	—	38	50	
Forward transfer admittance		$ Y_{fs} $	$V_{DS} = 10 \text{ V}, I_D = 2.0 \text{ A}$	3.4	6.8	—	S
Input capacitance		$C_{iss}$	$V_{DS} = 10 \text{ V}, V_{GS} = 0 \text{ V}, f = 1 \text{ MHz}$	—	470	—	pF
Reverse transfer capacitance		$C_{rss}$		—	60	—	
Output capacitance		$C_{oss}$		—	80	—	
Switching time	Rise time	$t_r$		—	5.2	—	ns
	Turn-on time	$t_{on}$		—	8.3	—	
	Fall time	$t_f$		—	4.0	—	
	Turn-off time	$t_{off}$		Duty $\leq 1\%$ , $t_w = 10 \mu\text{s}$	—	22	
Total gate charge (gate-source plus gate-drain)		$Q_g$	$V_{DD} \approx 24 \text{ V}, V_{GS} = 10 \text{ V}, I_D = 4 \text{ A}$	—	10	—	nC
Gate-source charge 1		$Q_{gs1}$		—	1.7	—	
Gate-drain ("miller") charge		$Q_{gd}$		—	2.4	—	

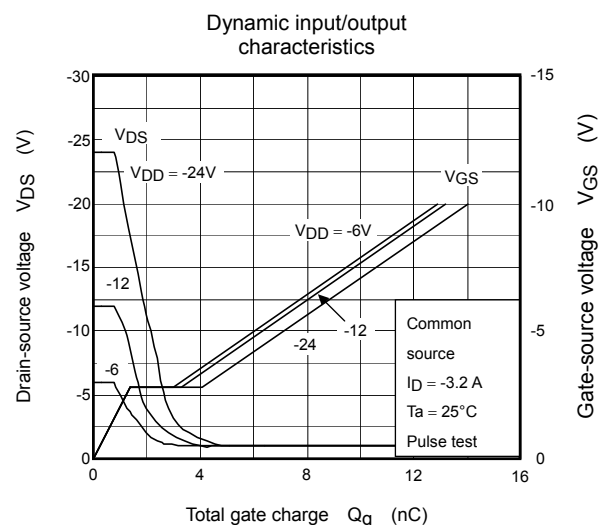
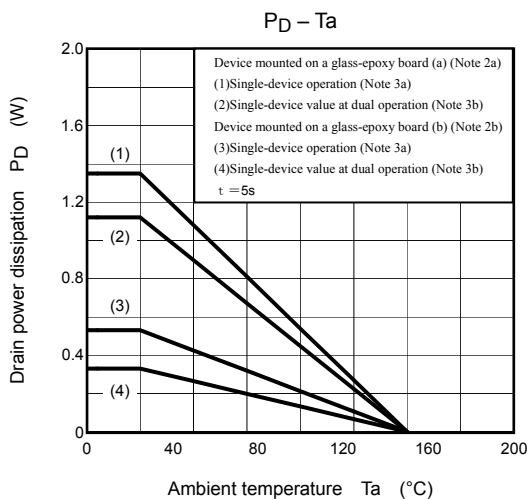
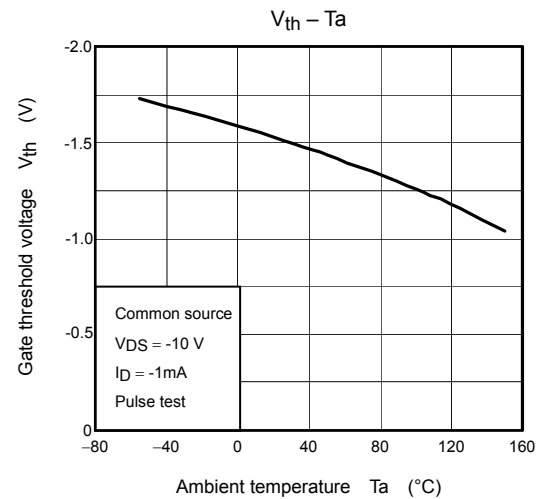
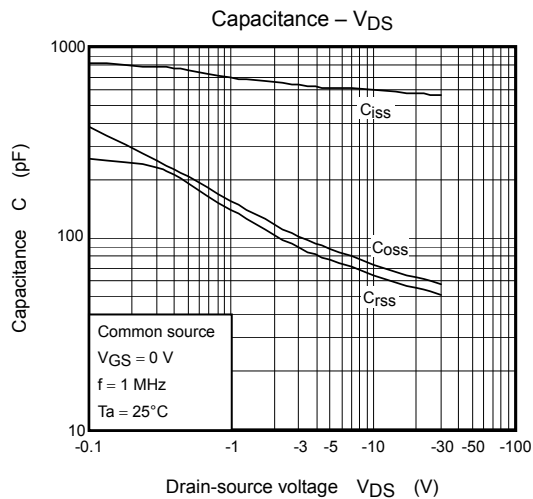
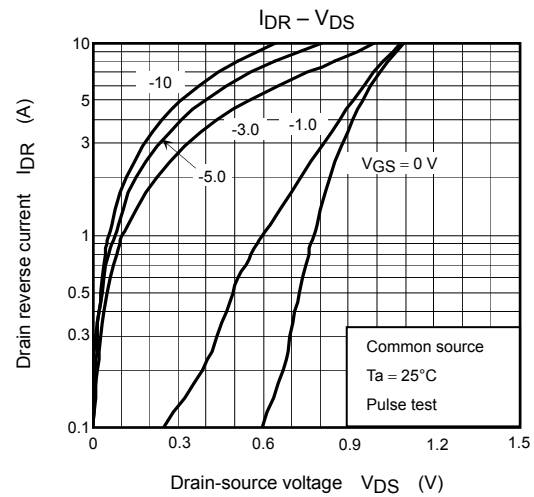
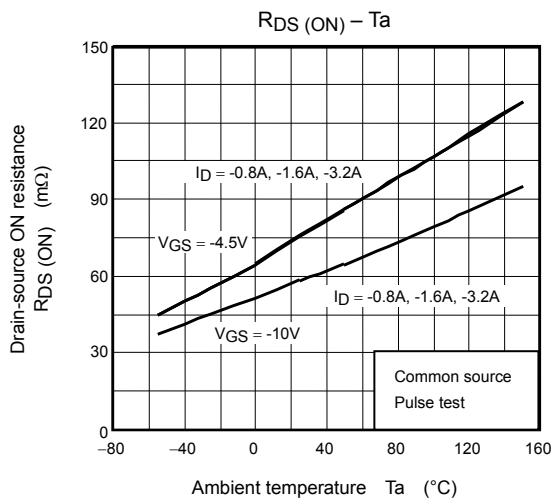
### Source-Drain Ratings and Characteristics (Ta = 25°C)

Characteristics		Symbol	Test Condition	Min	Typ.	Max	Unit
Drain reverse current	Pulse (Note 1)	$I_{DRP}$	—	—	—	16.0	A
Forward voltage (diode)		$V_{DSF}$	$I_{DR} = 4.0 \text{ A}, V_{GS} = 0 \text{ V}$	—	—	-1.2	V

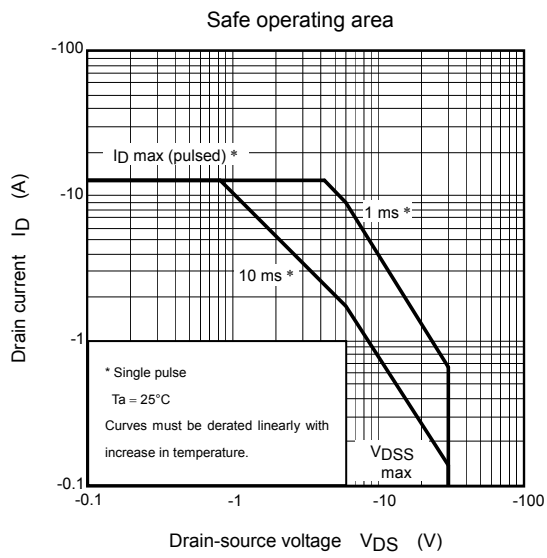
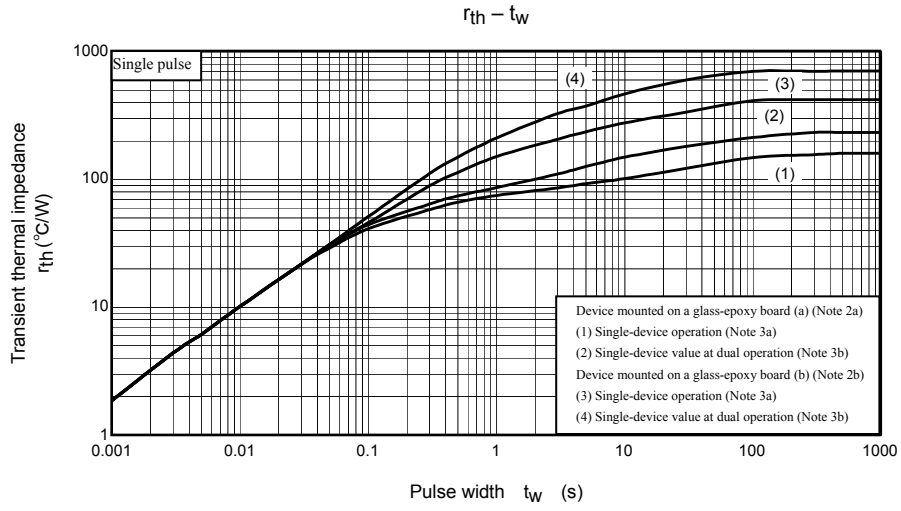
## P-channel



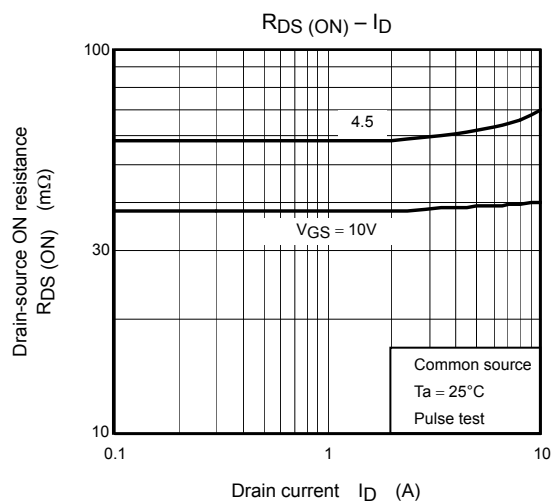
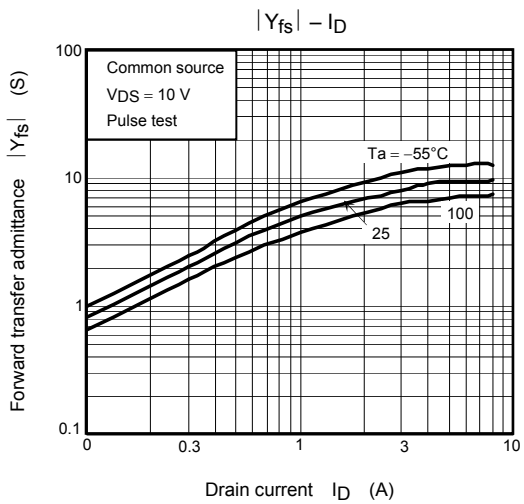
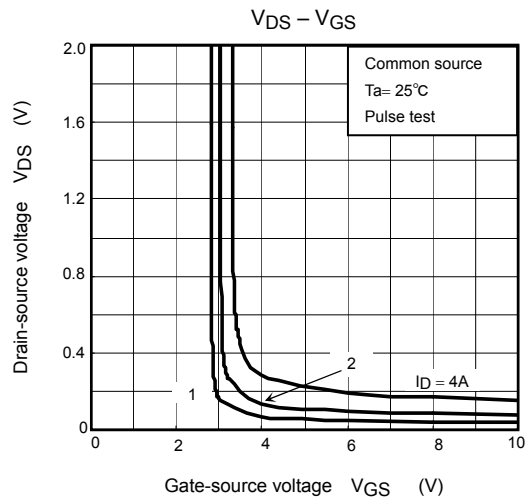
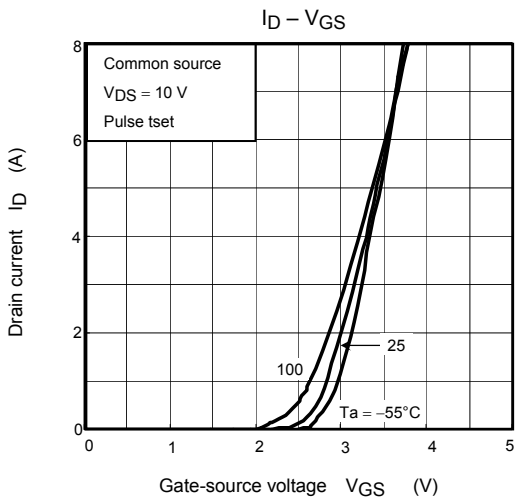
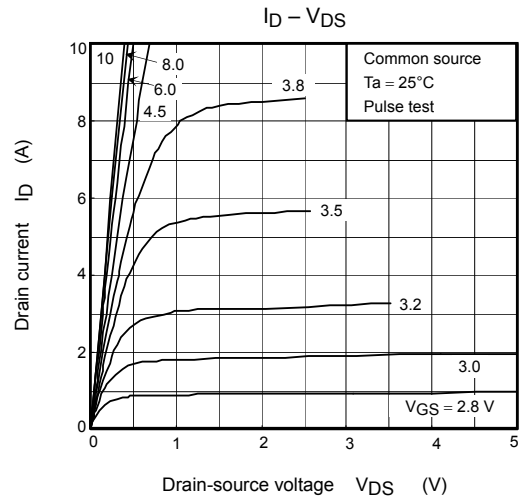
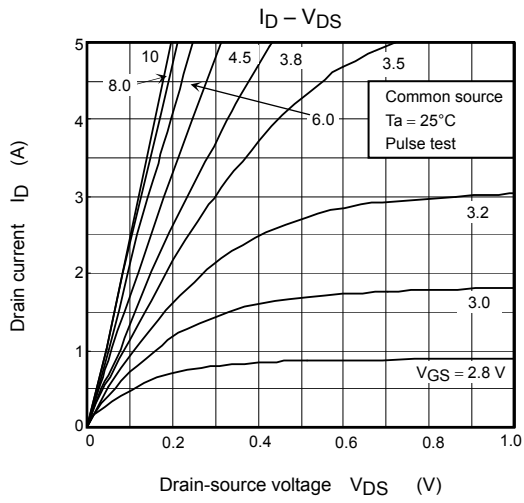
## P-channel



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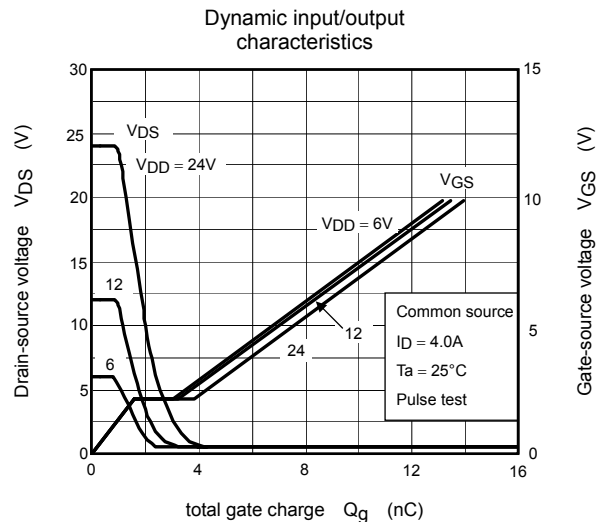
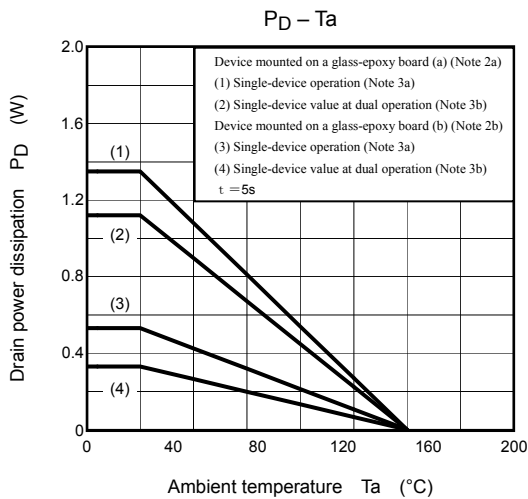
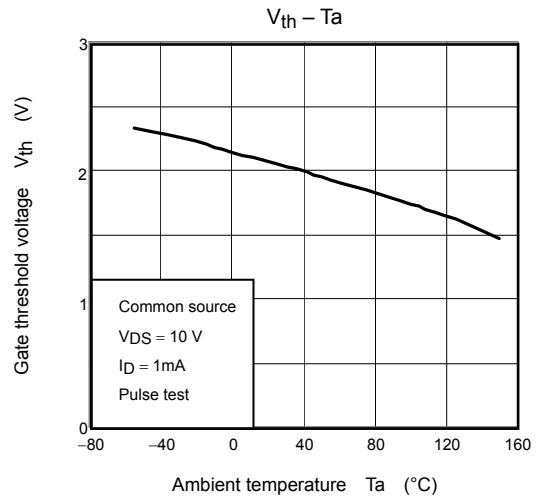
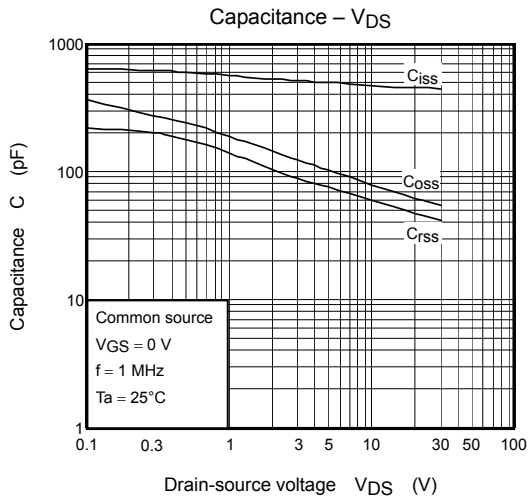
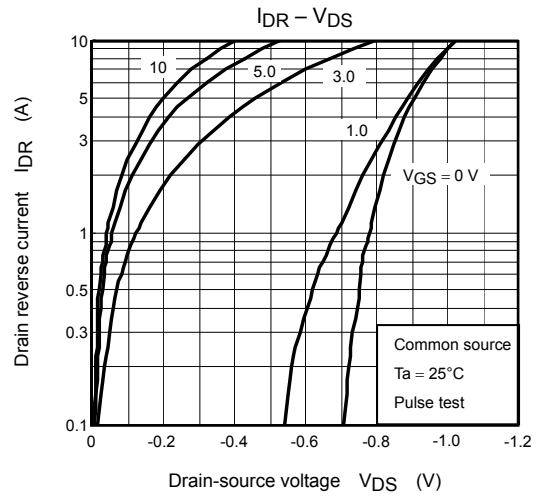
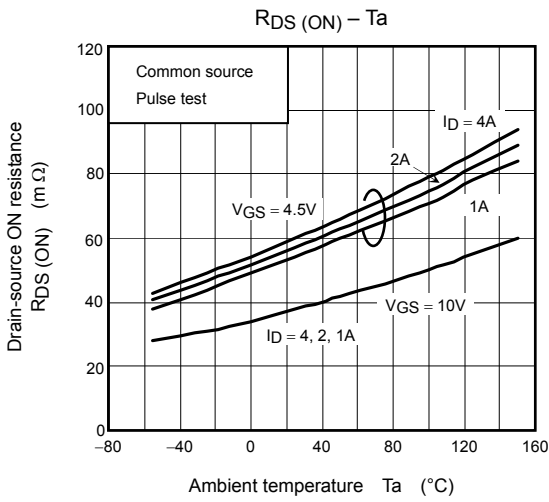


## N-channel

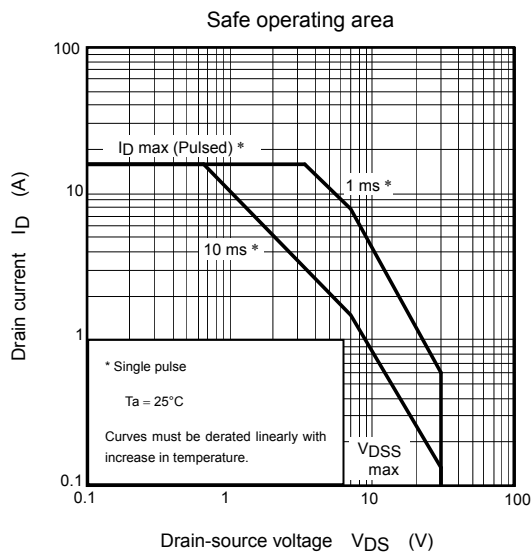
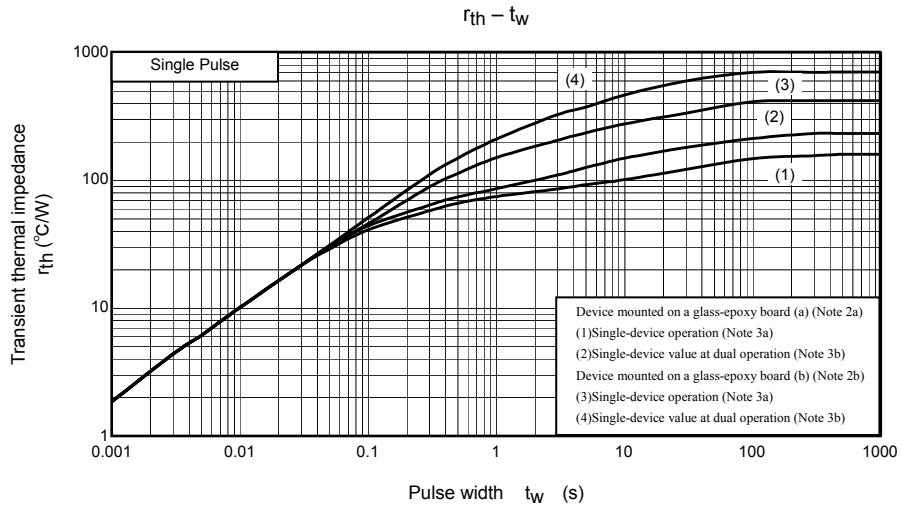




**N-channel**



## N-channel



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