

TOSHIBA Field Effect Transistor Silicon P/N-Channel MOS Type  
(P-Channel/N-Channel Ultra-High-Speed U-MOSIII)

# TPC8406-H

High Efficiency DC/DC Converter Applications

Notebook PC Applications

Portable Equipment Applications

CCFL Inverter Applications

- Small footprint due to a small and thin package
- High speed switching
- Low drain-source ON-resistance: P-Channel RDS (ON) = 24 mΩ (typ.)  
N-Channel RDS (ON) = 22 mΩ (typ.)
- Small gate charge: P-Channel Q<sub>SW</sub> = 9.7 nC (typ.)  
N-Channel Q<sub>SW</sub> = 3.5 nC (typ.)
- High forward transfer admittance: P-Channel |Y<sub>fs</sub>| = 13 S (typ.)  
N-Channel |Y<sub>fs</sub>| = 14 S (typ.)
- Low leakage current: P-Channel I<sub>DSS</sub> = -10 μA (V<sub>DS</sub> = -40 V)  
N-Channel I<sub>DSS</sub> = 10 μA (V<sub>DS</sub> = 40 V)
- Enhancement mode  
: P-Channel V<sub>th</sub> = -0.8 to -2.0 V (V<sub>DS</sub> = -10 V, I<sub>D</sub> = -1 mA)  
: N-Channel V<sub>th</sub> = 1.1 to 2.3 V (V<sub>DS</sub> = 10 V, I<sub>D</sub> = 1 mA)

## Absolute Maximum Ratings (Ta = 25°C)

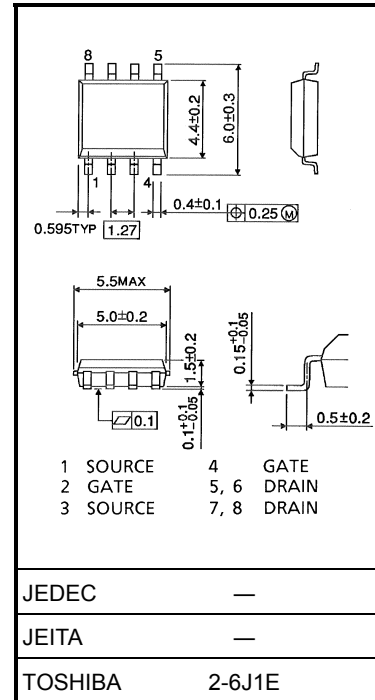
Characteristic	Symbol	Rating		Unit	
		P-Channel	N-Channel		
Drain-source voltage	V <sub>DSS</sub>	-40	40	V	
Drain-gate voltage (R <sub>GS</sub> = 20 kΩ)	V <sub>DGR</sub>	-40	40	V	
Gate-source voltage	V <sub>GSS</sub>	±20	±20	V	
Drain current	DC (Note 1)	I <sub>D</sub>	-6.5	6.5	A
	Pulse (Note 1)	I <sub>DP</sub>	-26	26	
Drain power dissipation (t = 10s) (Note 2a)	Single-device operation (Note 3a)	P <sub>D(1)</sub>	1.5	1.5	W
	Single-device value at dual operation (Note 3b)	P <sub>D(2)</sub>	1.1	1.1	
Drain power dissipation (t = 10s) (Note 2b)	Single-device operation (Note 3a)	P <sub>D(1)</sub>	0.75	0.75	W
	Single-device value at dual operation (Note 3b)	P <sub>D(2)</sub>	0.45	0.45	
Single-pulse avalanche energy	E <sub>AS</sub>	19 (Note 4a)	19 (Note 4b)	mJ	
Avalanche current	I <sub>AR</sub>	-6.5	6.5	A	
Repetitive avalanche energy Single-device value at operation (Note 2a, 3b, 5)	E <sub>AR</sub>	0.08		mJ	
Channel temperature	T <sub>ch</sub>	150		°C	
Storage temperature range	T <sub>stg</sub>	-55 to 150		°C	

Note: For Notes 1 to 4, 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).

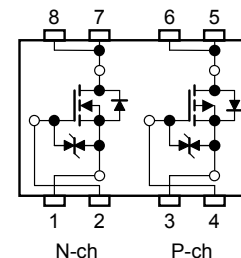
This transistor is an electrostatic-sensitive device. Handle with care.

Unit: mm



Weight: 0.085 g (typ.)

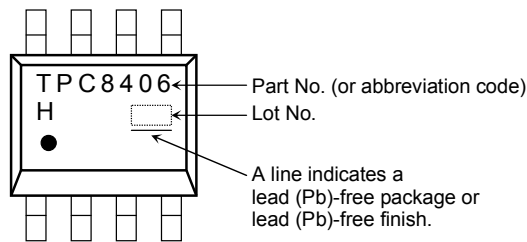
## Circuit Configuration



## Thermal Characteristics

Characteristic		Symbol	Max	Unit
Thermal resistance, channel to ambient (t = 10s) (Note 2a)	Single-device operation (Note 3a)	$R_{th(ch-a)}(1)$	83.3	°C/W
	Single-device value at dual operation (Note 3b)	$R_{th(ch-a)}(2)$	114	
Thermal resistance, channel to ambient (t = 10s) (Note 2b)	Single-device operation (Note 2a)	$R_{th(ch-a)}(1)$	167	
	Single-device value at dual operation (Note 2b)	$R_{th(ch-a)}(2)$	278	

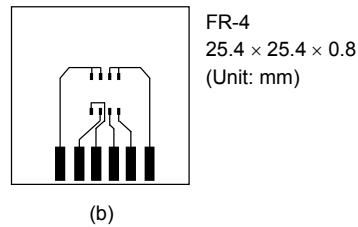
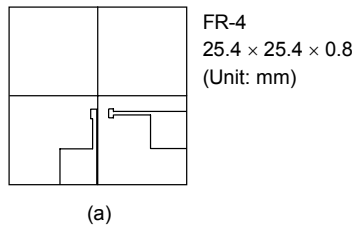
## Marking



Note 1: The channel temperature should not exceed 150°C during use.

Note 2:

- a) Device mounted on a glass-epoxy board (a)      b) Device mounted on a glass-epoxy board (b)



Note 3:

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

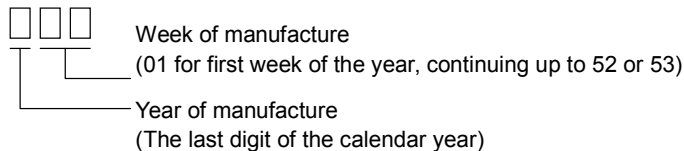
Note 4:

- a)  $V_{DD} = -24\text{ V}$ ,  $T_{ch} = 25^\circ\text{C}$  (Initial),  $L = 0.5\text{ mH}$ ,  $R_G = 25\ \Omega$ ,  $I_{AR} = -6.5\text{ A}$
- b)  $V_{DD} = 24\text{ V}$ ,  $T_{ch} = 25^\circ\text{C}$  (Initial),  $L = 0.5\text{ mH}$ ,  $R_G = 25\ \Omega$ ,  $I_{AR} = 6.5\text{ A}$

Note 5: Repetitive rating: pulse width limited by maximum channel temperature

Note 6: • on the lower left of the marking indicates Pin 1.

\* Weekly code: (Three digits)



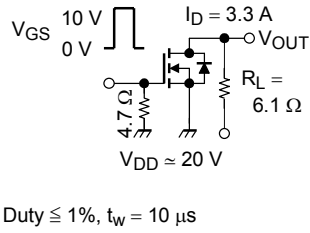
## P-Channel Electrical Characteristics (Ta = 25°C)

Characteristic		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 cutoff current		$I_{DSS}$	$V_{DS} = -40\text{ V}, V_{GS} = 0\text{ V}$	—	—	-10	$\mu\text{A}$
Drain-source breakdown voltage		$V_{(BR)DSS}$	$I_D = -10\text{ mA}, V_{GS} = 0\text{ V}$	-40	—	—	V
		$V_{(BR)DSX}$	$I_D = -10\text{ mA}, V_{GS} = 20\text{ V}$	-20	—	—	
Gate threshold voltage		$V_{th}$	$V_{DS} = -10\text{ V}, I_D = -1\text{ mA}$	-0.8	—	-2.0	V
Drain-source ON-resistance		$R_{DS(ON)}$	$V_{GS} = -4.5\text{ V}, I_D = -3.3\text{ A}$	—	29	37	m $\Omega$
			$V_{GS} = -10\text{ V}, I_D = -3.3\text{ A}$	—	24	30	
Forward transfer admittance		$ Y_{fs} $	$V_{DS} = -10\text{ V}, I_D = -3.3\text{ A}$	6.5	13	—	S
Input capacitance		$C_{iss}$	$V_{DS} = -10\text{ V}, V_{GS} = 0\text{ V}, f = 1\text{ MHz}$	—	1190	—	pF
Reverse transfer capacitance		$C_{rSS}$		—	170	—	
Output capacitance		$C_{oss}$		—	250	—	
Switching time	Rise time	$t_r$		—	5	—	ns
	Turn-on time	$t_{on}$		—	12	—	
	Fall time	$t_f$		—	12	—	
	Turn-off time	$t_{off}$		—	43	—	
Total gate charge (gate-source plus gate-drain)		$Q_g$	$V_{DD} \approx -32\text{ V}, V_{GS} = -10\text{ V}, I_D = -6.5\text{ A}$	—	27	—	nC
			$V_{DD} \approx -32\text{ V}, V_{GS} = -5\text{ V}, I_D = -6.5\text{ A}$	—	15	—	
Gate-source charge 1		$Q_{gs1}$	$V_{DD} \approx -32\text{ V}, V_{GS} = -10\text{ V}, I_D = -6.5\text{ A}$	—	3.2	—	
Gate-drain ("Miller") charge		$Q_{gd}$		—	8.1	—	
Gate switch charge		$Q_{SW}$		—	9.7	—	

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

Characteristic		Symbol	Test Condition	Min	Typ.	Max	Unit
Drain reverse current	Pulse (Note 1)	$I_{DRP}$	—	—	—	-26	A
Forward voltage (diode)		$V_{DSF}$	$I_{DR} = -6.5\text{ A}, V_{GS} = 0\text{ V}$	—	—	1.2	V

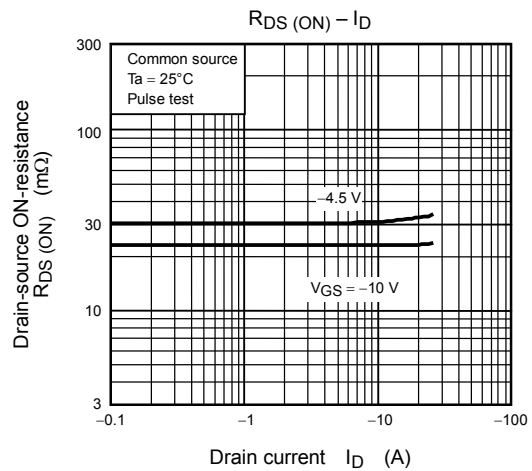
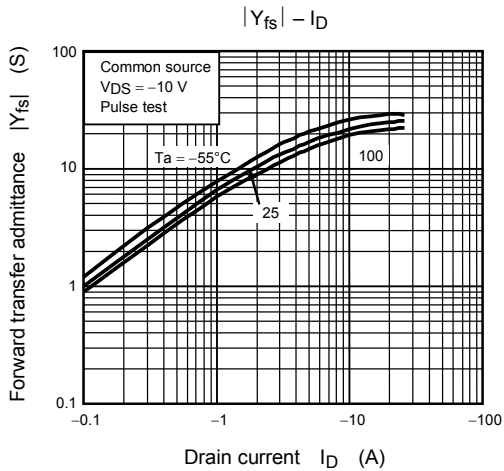
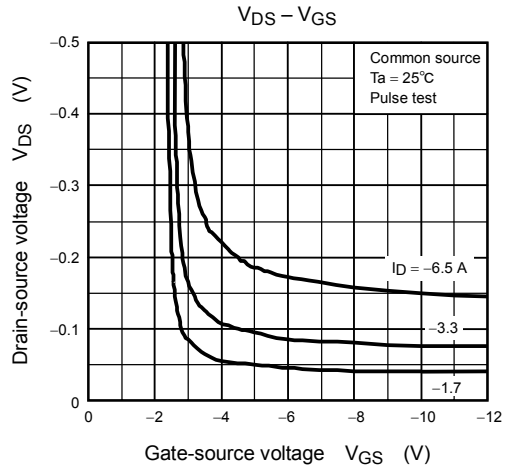
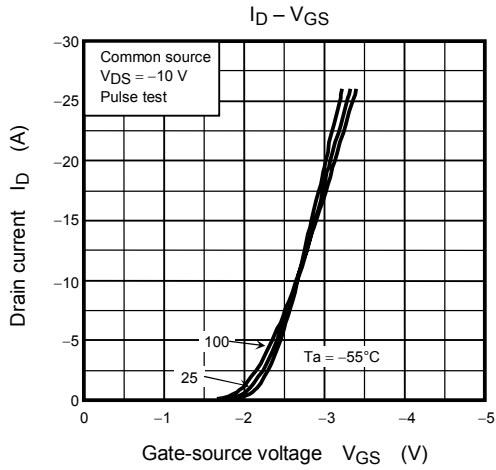
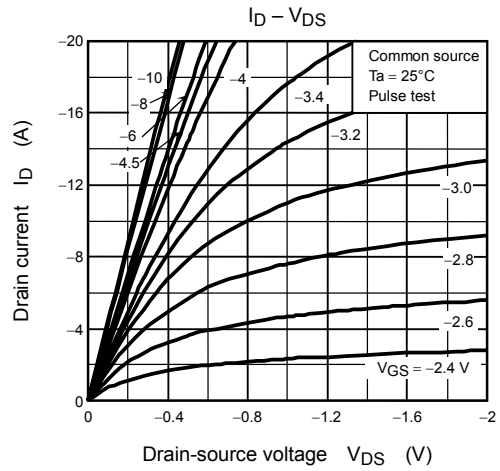
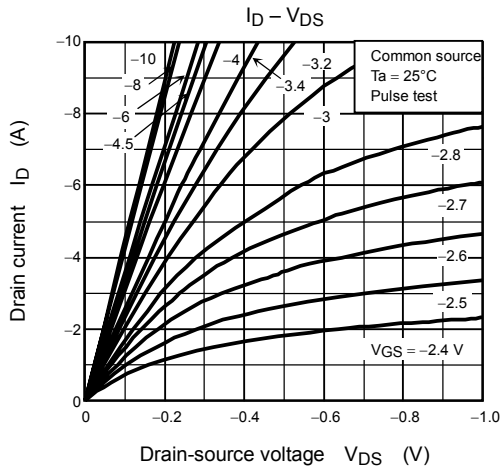
## N-channel Electrical Characteristics (Ta = 25°C)

Characteristic		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 cutoff current		$I_{DSS}$	$V_{DS} = 40\text{ V}, V_{GS} = 0\text{ V}$	—	—	10	$\mu\text{A}$
Drain-source breakdown voltage		$V_{(BR)DSS}$	$I_D = 10\text{ mA}, V_{GS} = 0\text{ V}$	40	—	—	V
		$V_{(BR)DSX}$	$I_D = 10\text{ mA}, V_{GS} = -20\text{ V}$	25	—	—	
Gate threshold voltage		$V_{th}$	$V_{DS} = 10\text{ V}, I_D = 1\text{ mA}$	1.1	—	2.3	V
Drain-source ON-resistance		$R_{DS(ON)}$	$V_{GS} = 4.5\text{ V}, I_D = 3.3\text{ A}$	—	27	35	m $\Omega$
			$V_{GS} = 10\text{ V}, I_D = 3.3\text{ A}$	—	22	27	
Forward transfer admittance		$ Y_{fs} $	$V_{DS} = 10\text{ V}, I_D = 3.3\text{ A}$	7	14	—	S
Input capacitance		$C_{iss}$	$V_{DS} = 10\text{ V}, V_{GS} = 0\text{ V}, f = 1\text{ MHz}$	—	650	—	pF
Reverse transfer capacitance		$C_{rss}$		—	55	—	
Output capacitance		$C_{oss}$		—	240	—	
Switching time	Rise time	$t_r$		—	3	—	ns
	Turn-on time	$t_{on}$		—	9	—	
	Fall time	$t_f$		—	2	—	
	Turn-off time	$t_{off}$		—	18	—	
Total gate charge (gate-source plus gate-drain)		$Q_g$	$V_{DD} \approx 32\text{ V}, V_{GS} = 10\text{ V}, I_D = 6.5\text{ A}$	—	11	—	nC
			$V_{DD} \approx 32\text{ V}, V_{GS} = 5\text{ V}, I_D = 6.5\text{ A}$	—	6.2	—	
Gate-source charge 1		$Q_{gs1}$	$V_{DD} \approx 32\text{ V}, V_{GS} = 10\text{ V}, I_D = 6.5\text{ A}$	—	2.1	—	
Gate-drain ("Miller") charge		$Q_{gd}$		—	2.7	—	
Gate switch charge		$Q_{SW}$		—	3.5	—	

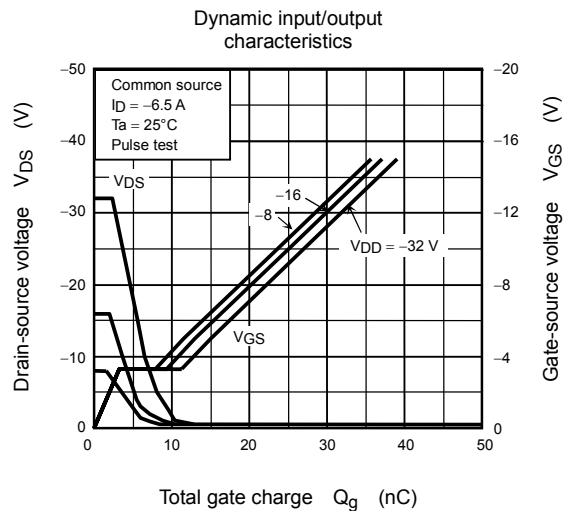
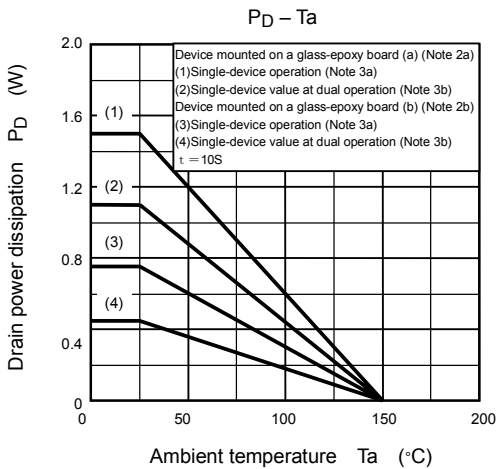
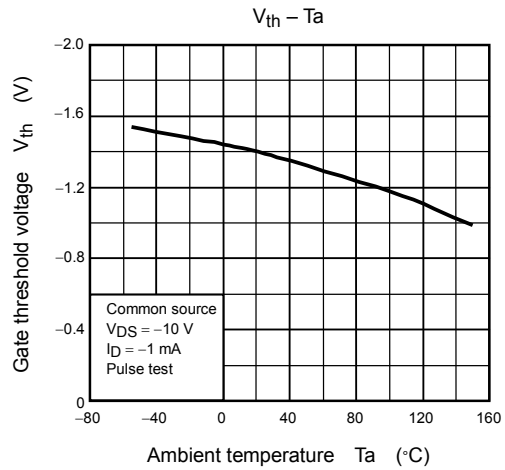
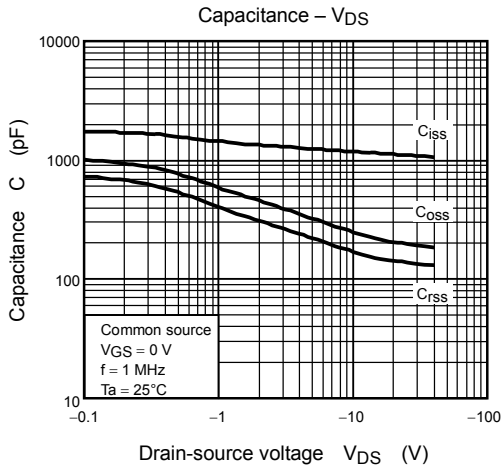
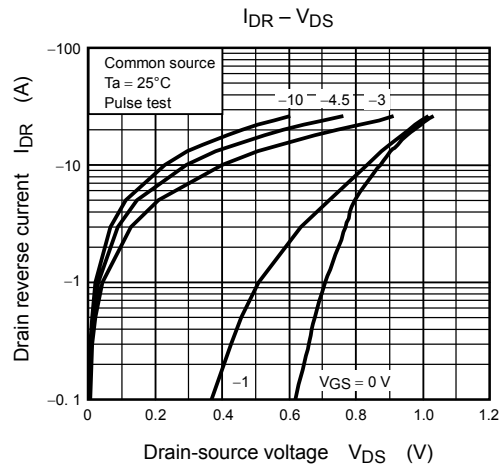
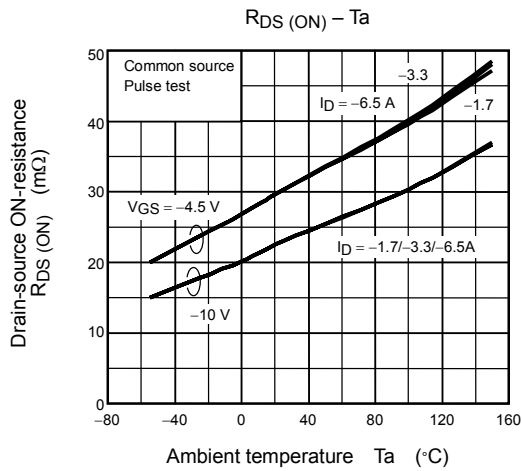
## Source-Drain Ratings and Characteristics (Ta = 25°C)

Characteristic		Symbol	Test Condition	Min	Typ.	Max	Unit
Drain reverse current	Pulse (Note 1)	$I_{DRP}$	—	—	—	26	A
Forward voltage (diode)		$V_{DSF}$	$I_{DR} = 6.5\text{ A}, V_{GS} = 0\text{ V}$	—	—	-1.2	V

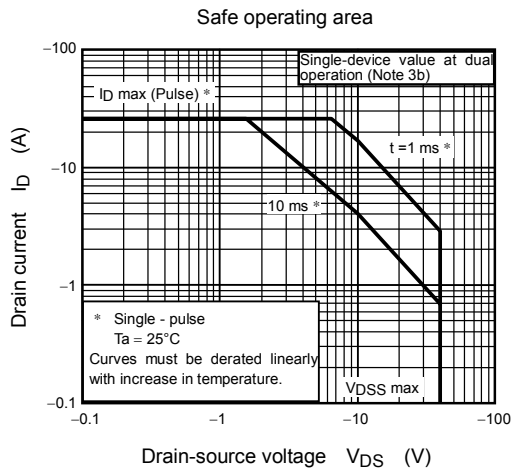
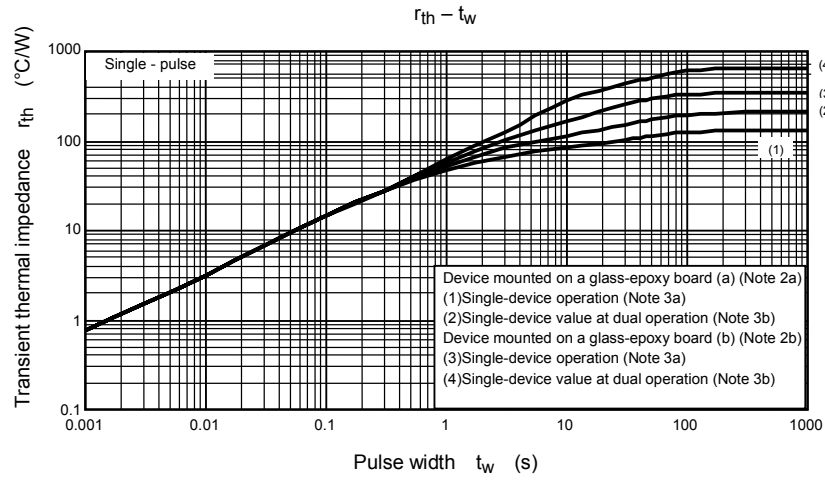
P-Channel



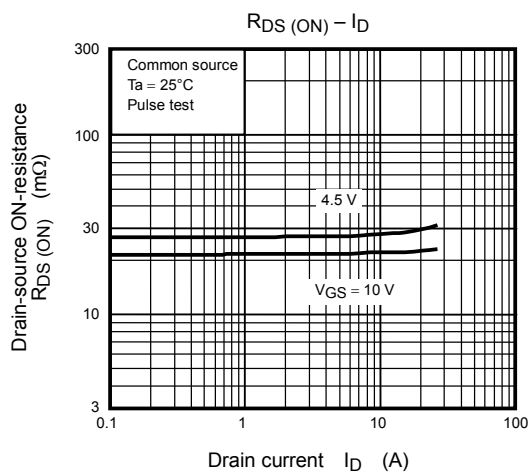
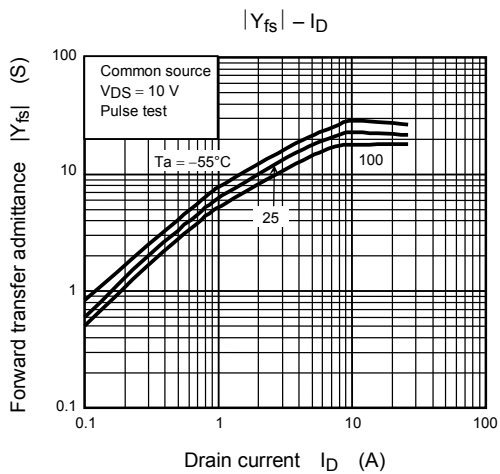
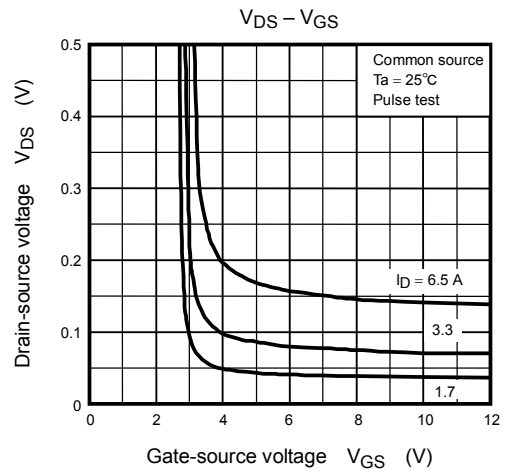
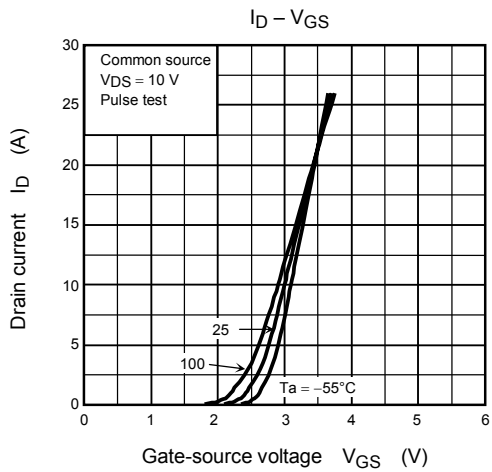
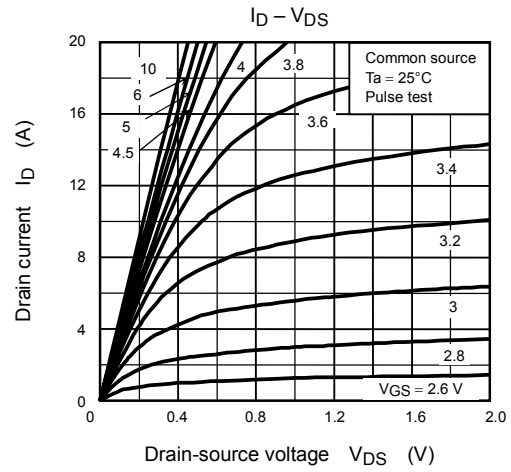
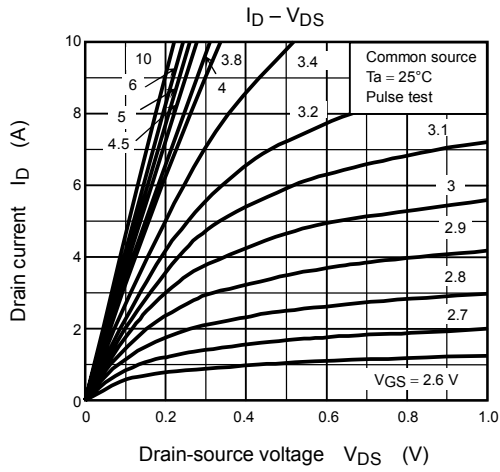
## P-Channel



## P-Channel

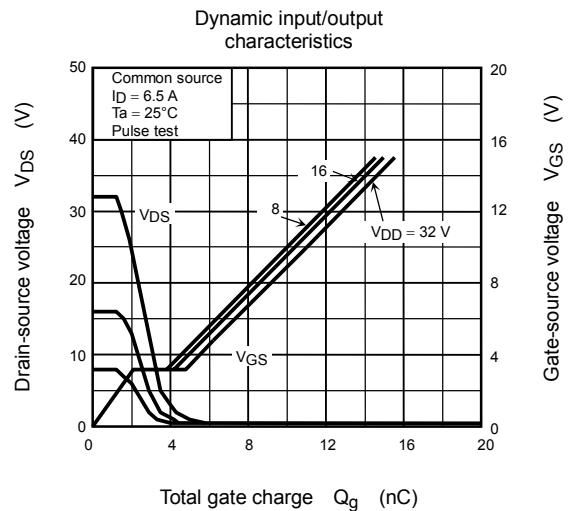
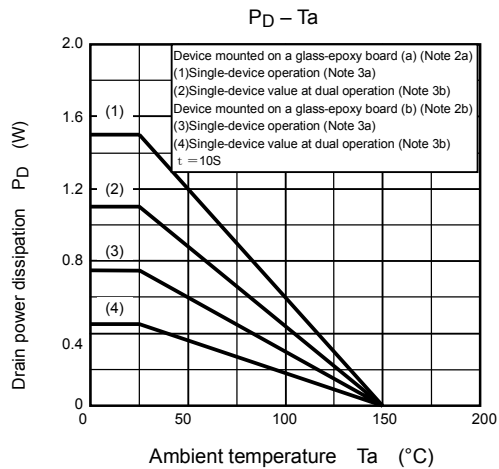
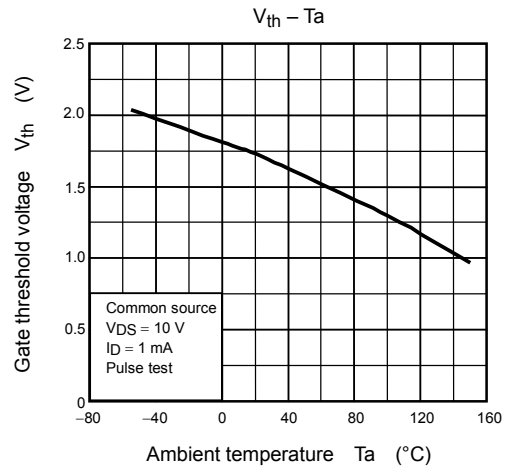
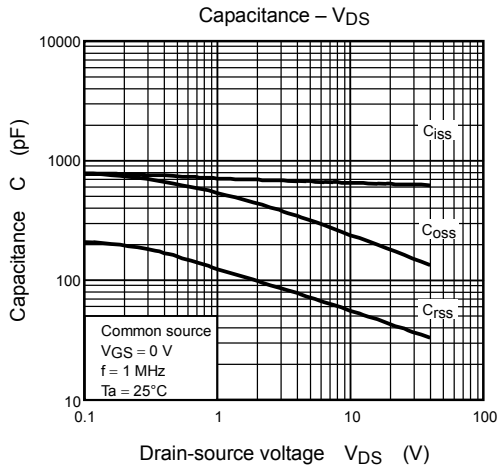
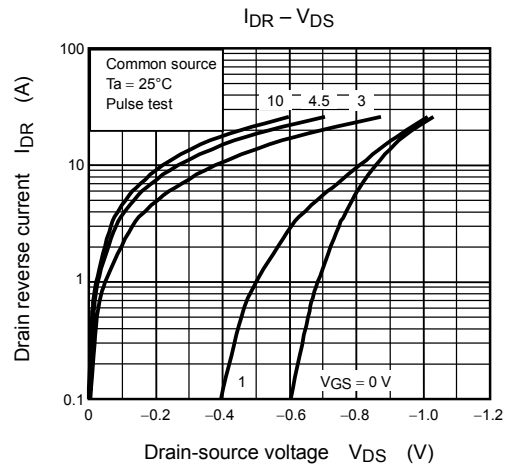
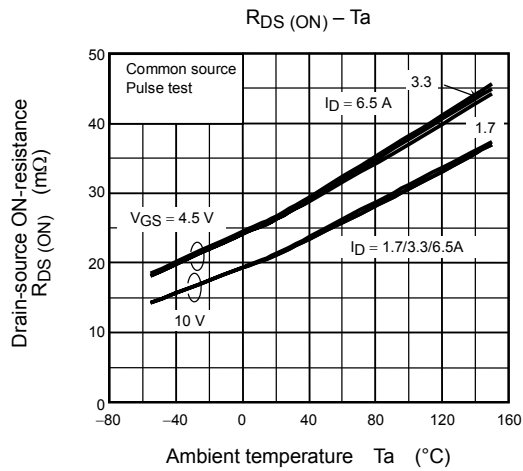


**N-Channel**

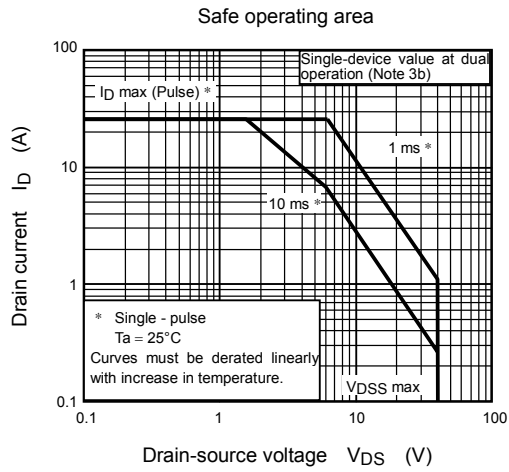
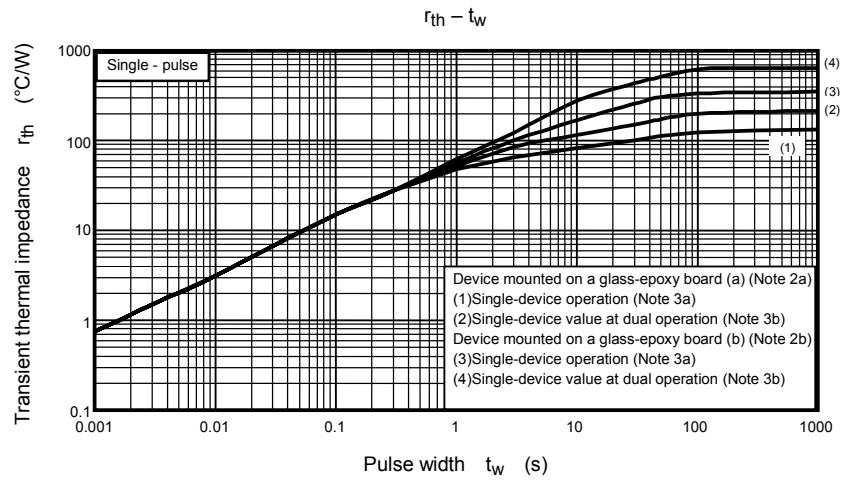




## N-Channel



## N-Channel



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