

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

# TPC8405

Lithium Ion Secondary Battery Applications

Portable Equipment Applications

Notebook PC Applications

- Low drain-source ON resistance : P Channel  $R_{DS(ON)} = 25 \text{ m}\Omega$  (typ.)  
N Channel  $R_{DS(ON)} = 20 \text{ m}\Omega$  (typ.)
- High forward transfer admittance : P Channel  $|Y_{fs}| = 12\text{S}$  (typ.)  
N Channel  $|Y_{fs}| = 14\text{S}$  (typ.)
- Low leakage current : P Channel  $I_{DSS} = -10 \mu\text{A}$  ( $V_{DS} = -30 \text{ V}$ )  
N Channel  $I_{DSS} = 10 \mu\text{A}$  ( $V_{DS} = 30 \text{ V}$ )
- 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 (Ta = 25°C)

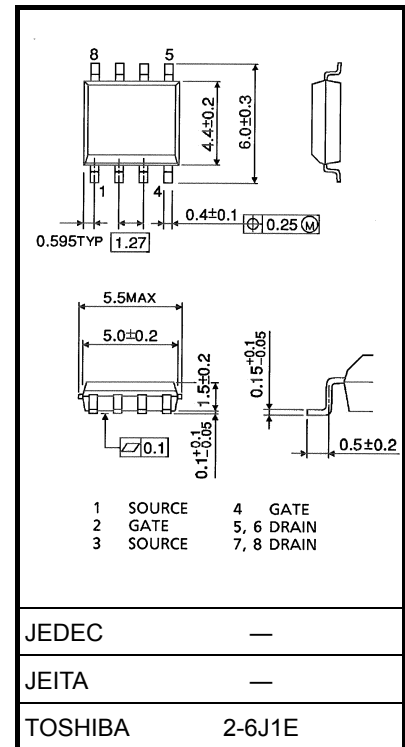
Characteristics		Symbol	Rating		Unit
			P Channel	N Channel	
Drain-source voltage		$V_{DSS}$	-30	30	V
Drain-gate voltage ( $R_{GS} = 20 \text{ k}\Omega$ )		$V_{DGR}$	-30	30	V
Gate-source voltage		$V_{GSS}$	$\pm 20$	$\pm 20$	V
Drain current	DC (Note 1)	$I_D$	-4.5	6	A
	Pulse (Note 1)	$I_{DP}$	-18	24	
Drain power dissipation ( $t = 10\text{s}$ ) (Note 2a)	Single-device operation (Note 3a)	$P_D(1)$	1.5	1.5	W
	Single-device value at dual operation (Note 3b)	$P_D(2)$	1.1	1.1	
Drain power dissipation ( $t = 10\text{s}$ ) (Note 2b)	Single-device operation (Note 3a)	$P_D(1)$	0.75	0.75	
	Single-device value at dual operation (Note 3b)	$P_D(2)$	0.45	0.45	
Single pulse avalanche energy		$E_{AS}$	13.2 (Note 4a)	23.4 (Note 4b)	mJ
Avalanche current		$I_{AR}$	-4.5	6	A
Repetitive avalanche energy Single-device value at operation (Note 2a, 3b, 5)		$E_{AR}$	0.1		mJ
Channel temperature		$T_{ch}$	150		°C
Storage temperature range		$T_{stg}$	-55 to 150		°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).

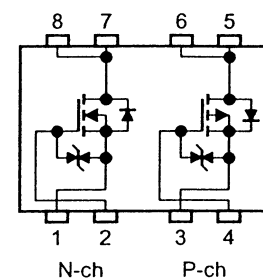
This transistor is an electrostatic-sensitive device. Handle with care.

Unit: mm



Weight: 0.080 g (typ.)

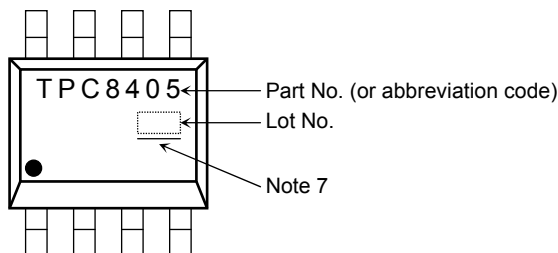
## Circuit Configuration



## Thermal Characteristics

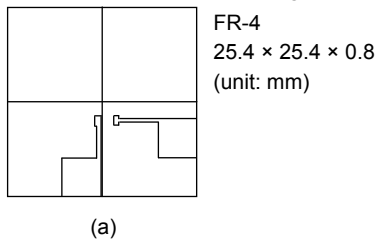
Characteristics		Symbol	Max	Unit
Thermal resistance, channel to ambient (t = 10s)	Single-device operation (Note 3a)	$R_{th(ch-a)}(1)$	83.3	°C/W
	Single-device value at dual operation (Note 3b)	$R_{th(ch-a)}(2)$	114	
Thermal resistance, channel to ambient (t = 10s)	Single-device operation (Note 3a)	$R_{th(ch-a)}(1)$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

## Marking (Note 6)

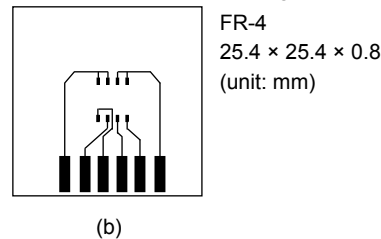


Note 1: Ensure that the channel temperature does not exceed 150°C.

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



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



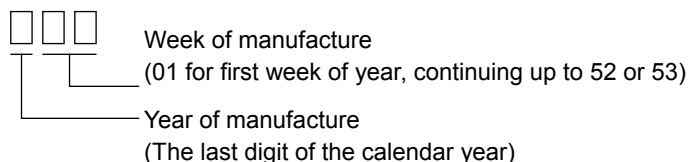
Note 3: a) The power dissipation and thermal resistance values shown are for a single device. (During single-device operation, power is applied to one device only.)  
 b) The power dissipation and thermal resistance values shown are for a single device. (During dual operation, power is evenly applied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

Note 4: a)  $V_{DD} = -24\text{ V}$ ,  $T_{ch} = 25^\circ\text{C}$  (initial),  $L = 0.5\text{ mH}$ ,  $R_G = 25\ \Omega$ ,  $I_{AR} = -4.5\text{ A}$   
 b)  $V_{DD} = 24\text{ V}$ ,  $T_{ch} = 25^\circ\text{C}$  (initial),  $L = 0.5\text{ mH}$ ,  $R_G = 25\ \Omega$ ,  $I_{AR} = 6.0\text{ A}$

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)



Note 7: 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.

## P-ch

### 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		$R_{DS(ON)}$	$V_{GS} = -4.5\text{ V}, I_D = -2.2\text{ A}$	—	32	42	m $\Omega$
		$R_{DS(ON)}$	$V_{GS} = -10\text{ V}, I_D = -2.2\text{ A}$	—	25	33	
Forward transfer admittance		$ Y_{fs} $	$V_{DS} = -10\text{ V}, I_D = -2.2\text{ A}$	6	12	—	S
Input capacitance		$C_{iss}$	$V_{DS} = -10\text{ V}, V_{GS} = 0\text{ V}, f = 1\text{ MHz}$	—	1540	—	pF
Reverse transfer capacitance		$C_{rss}$		—	220	—	
Output capacitance		$C_{oss}$		—	250	—	
Switching time	Rise time	$t_r$	<p><math>V_{GS} = 0\text{ V}, -10\text{ V}</math>  <math>I_D = -2.2\text{ A}</math>  <math>V_{OUT}</math>  <math>R_L = 6.8\ \Omega</math>  <math>V_{DD} = -15\text{ V}</math>  <math>Duty \leq 1\%, t_w = 10\ \mu\text{s}</math></p>	—	5.0	—	ns
	Turn-ON time	$t_{on}$		—	13	—	
	Fall time	$t_f$		—	35	—	
	Turn-OFF time	$t_{off}$		—	125	—	
Total gate charge (Gate-source plus gate-drain)		$Q_g$	$V_{DD} \approx -24\text{ V}, V_{GS} = -10\text{ V}, I_D = -4.5\text{ A}$	—	40	—	nC
Gate-source charge 1		$Q_{gs1}$		—	4.4	—	
Gate-drain ("miller") charge		$Q_{gd}$		—	8.2	—	

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

Characteristics		Symbol	Test Condition	Min	Typ.	Max	Unit
Drain reverse current	Pulse (Note 1)	$I_{DRP}$	—	—	—	-18	A
Forward voltage (diode)		$V_{DSF}$	$I_{DR} = -4.5\text{ A}, V_{GS} = 0\text{ V}$	—	—	1.2	V

## N-ch

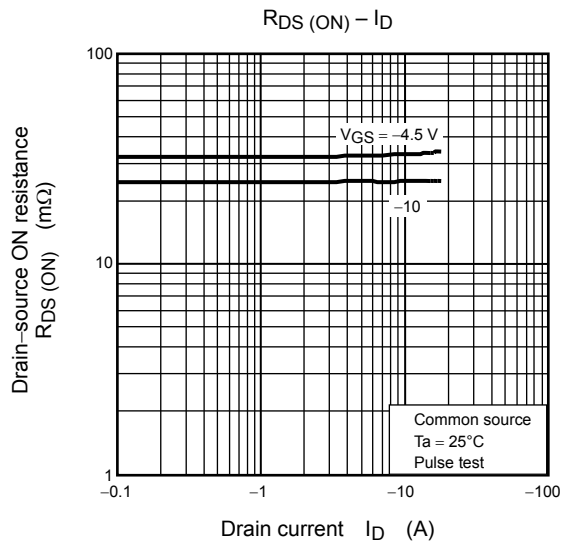
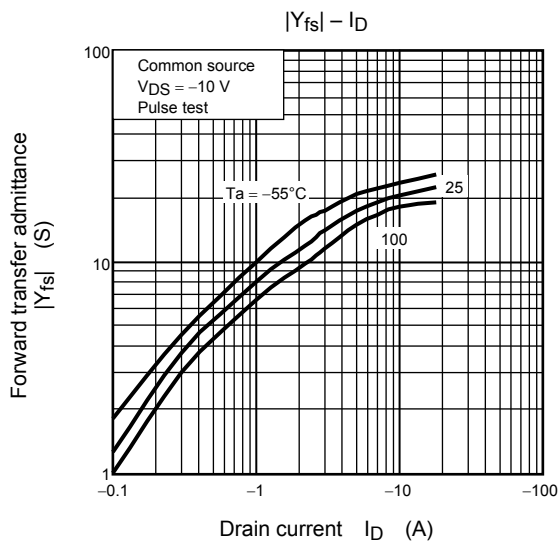
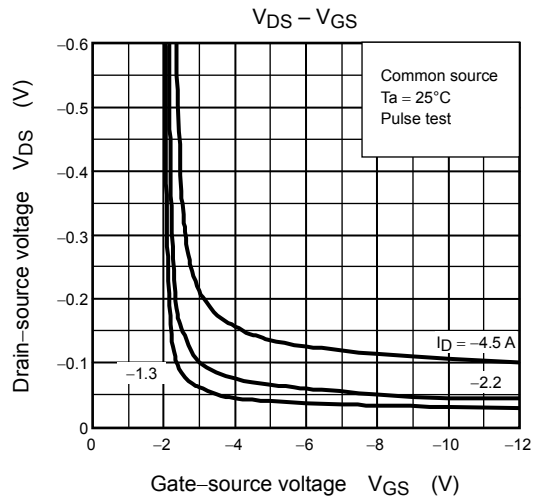
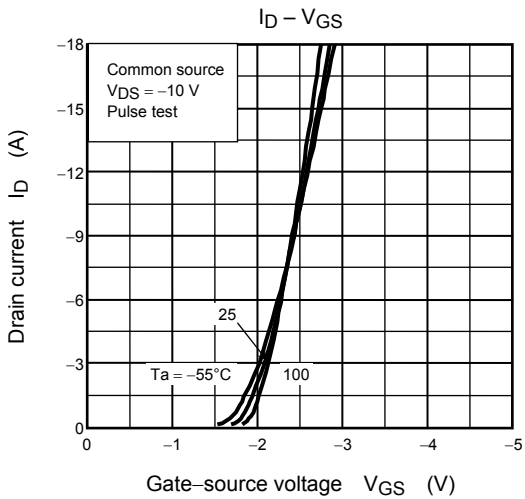
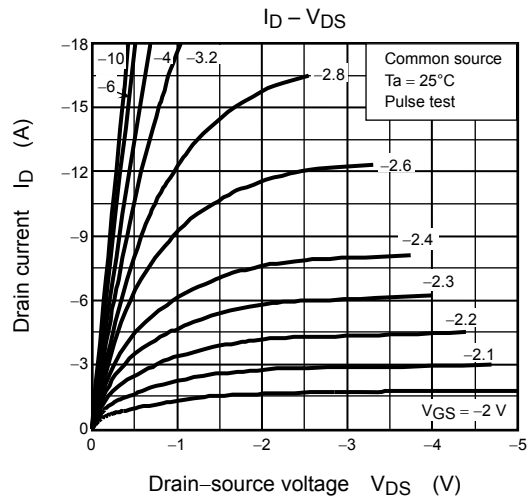
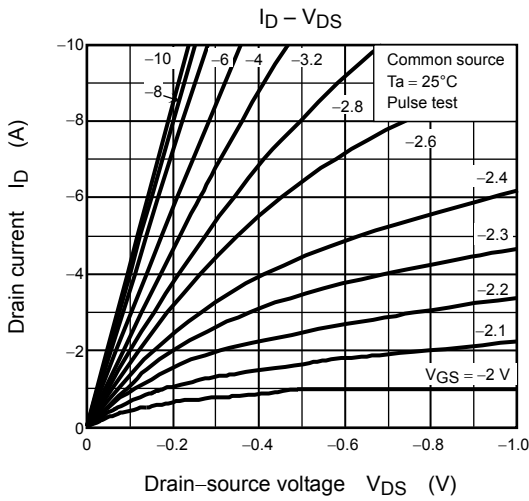
### Electrical Characteristics (Ta = 25°C)

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		$R_{DS(ON)}$	$V_{GS} = 4.5\text{ V}, I_D = 3\text{ A}$	—	25	33	m $\Omega$
		$R_{DS(ON)}$	$V_{GS} = 10\text{ V}, I_D = 3\text{ A}$	—	20	26	
Forward transfer admittance		$ Y_{fs} $	$V_{DS} = 10\text{ V}, I_D = 3\text{ A}$	7	14	—	S
Input capacitance		$C_{iss}$	$V_{DS} = 10\text{ V}, V_{GS} = 0\text{ V}, f = 1\text{ MHz}$	—	1240	—	pF
Reverse transfer capacitance		$C_{rss}$		—	180	—	
Output capacitance		$C_{oss}$		—	230	—	
Switching time	Rise time	$t_r$	<p> <math>V_{GS} = 10\text{ V}</math>  <math>V_{GS} = 0\text{ V}</math>  <math>I_D = 3.0\text{ A}</math>  <math>V_{OUT}</math>  <math>R_L = 5.0\ \Omega</math>  <math>V_{DD} \doteq 15\text{ V}</math>  <math>\text{Duty} \leq 1\%, t_w = 10\ \mu\text{s}</math> </p>	—	4.5	—	ns
	Turn-ON time	$t_{on}$		—	12.5	—	
	Fall time	$t_f$		—	6.6	—	
	Turn-OFF time	$t_{off}$		—	33	—	
Total gate charge (Gate-source plus gate-drain)		$Q_g$	$V_{DD} \approx 24\text{ V}, V_{GS} = 10\text{ V}, I_D = 6\text{ A}$	—	27	—	nC
Gate-source charge 1		$Q_{gs1}$		—	3.9	—	
Gate-drain ("miller") charge		$Q_{gd}$		—	7.0	—	

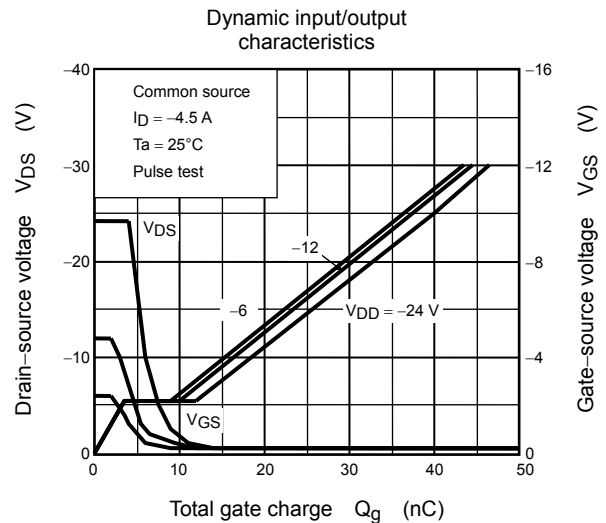
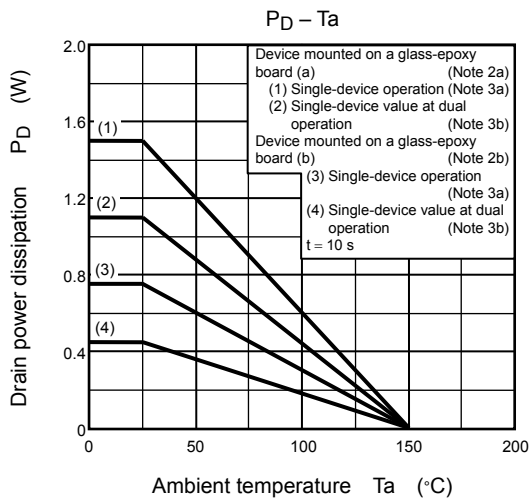
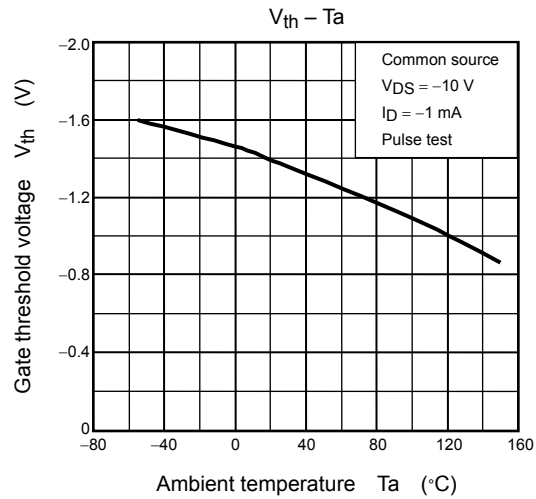
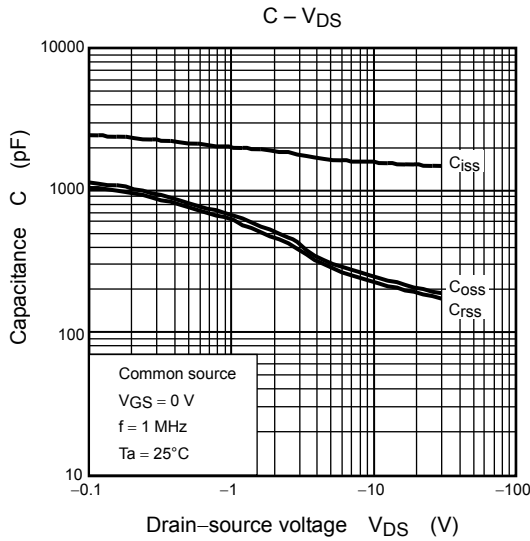
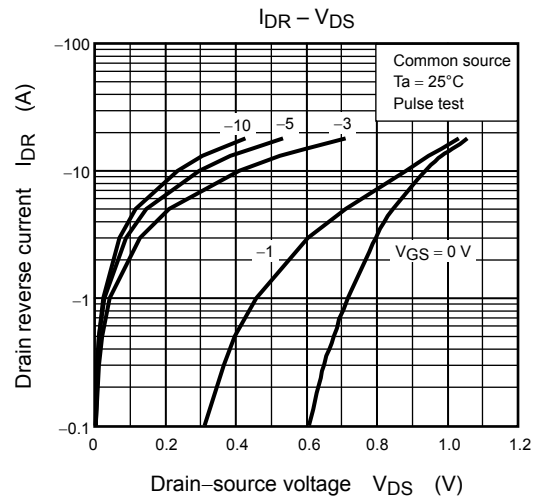
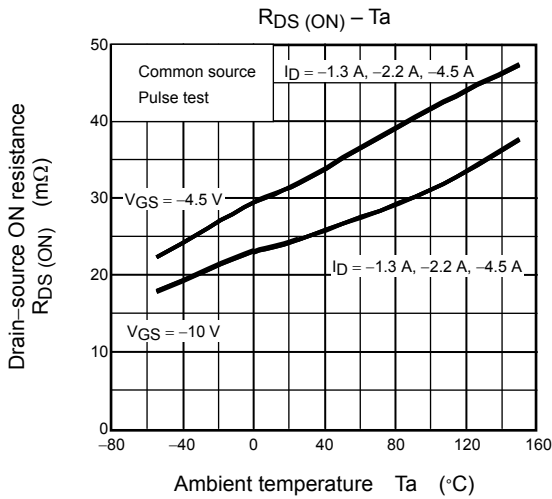
### Source-Drain Ratings and Characteristics (Ta = 25°C)

Characteristics		Symbol	Test Condition	Min	Typ.	Max	Unit
Drain reverse current	Pulse (Note 1)	$I_{DRP}$	—	—	—	24	A
Forward voltage (diode)		$V_{DSF}$	$I_{DR} = 6\text{ A}, V_{GS} = 0\text{ V}$	—	—	-1.2	V

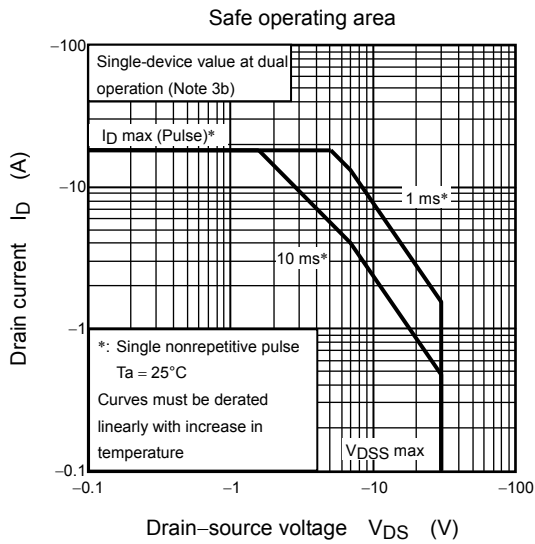
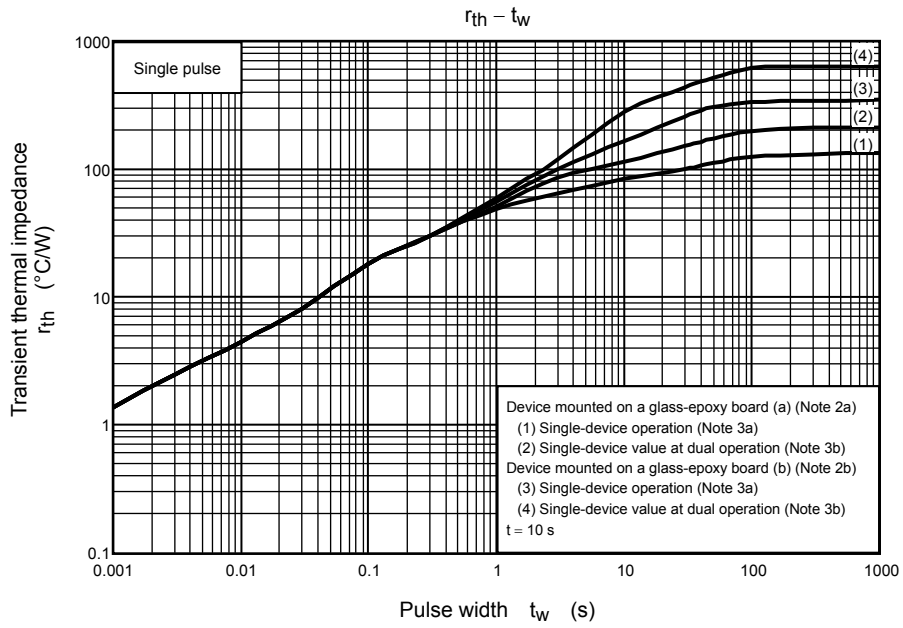
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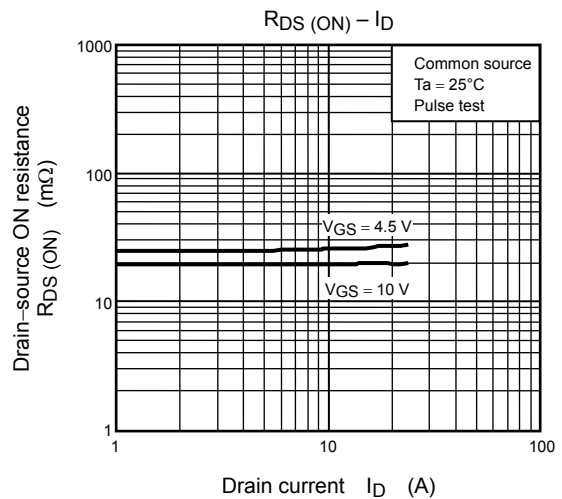
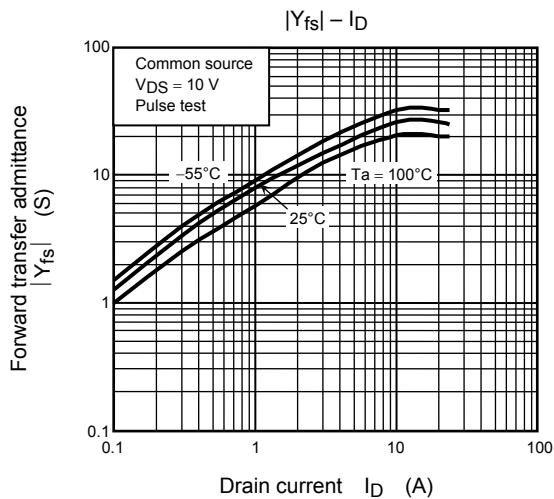
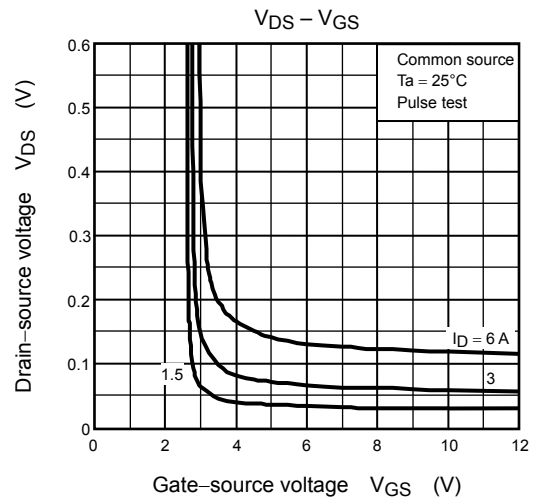
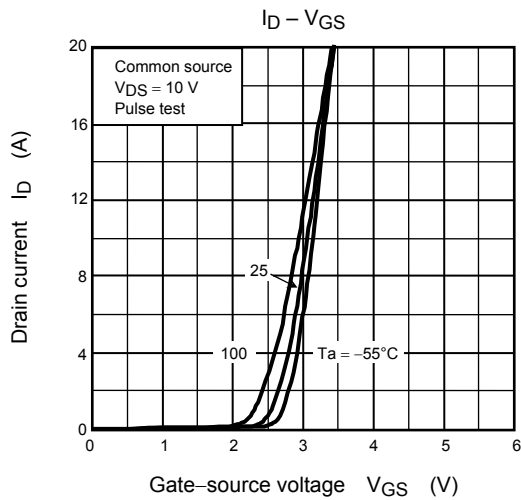
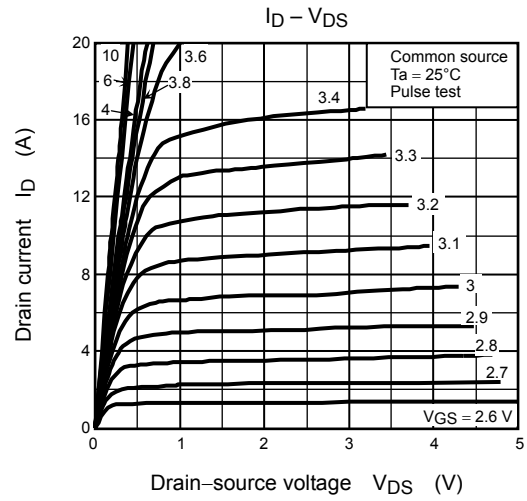
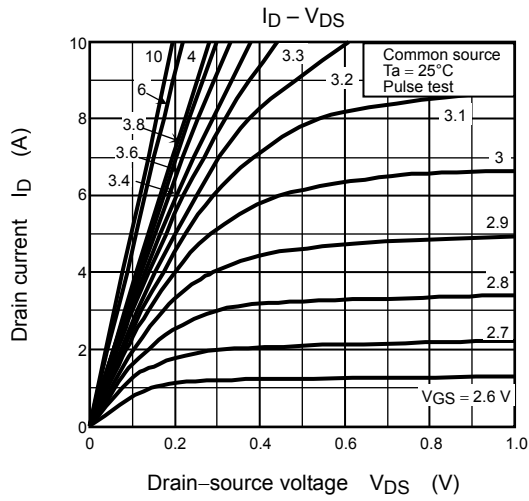
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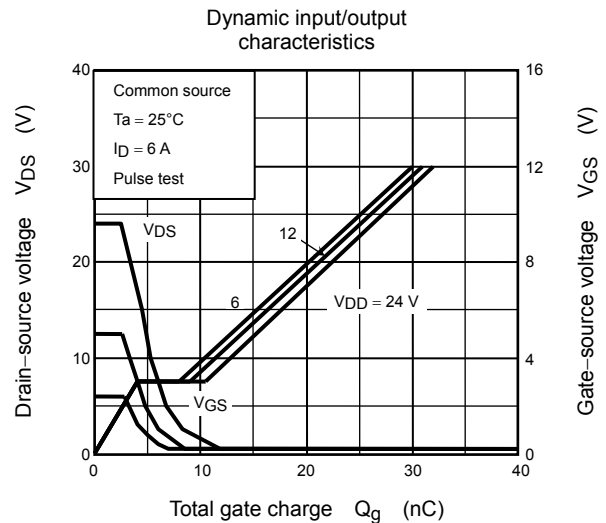
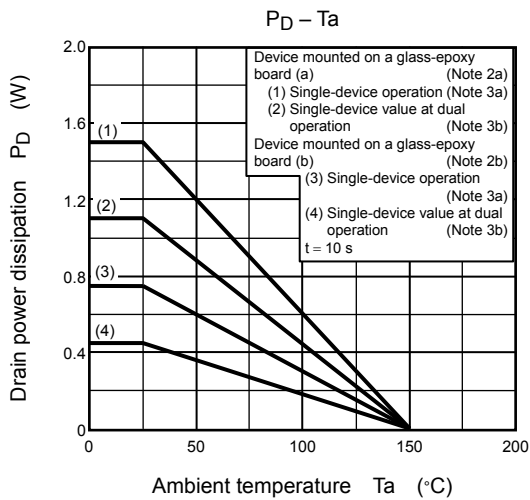
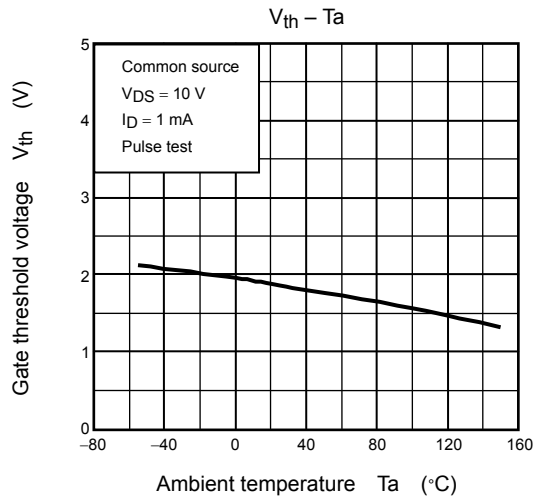
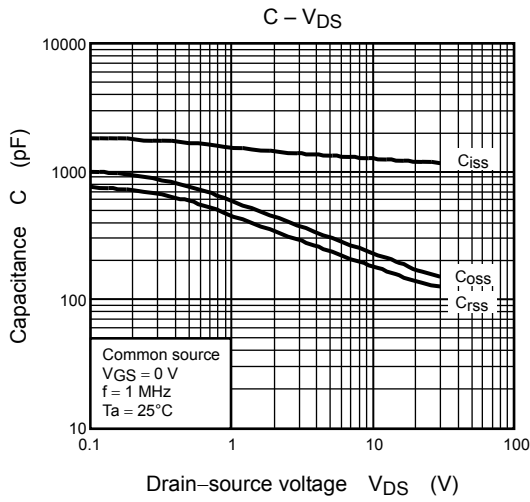
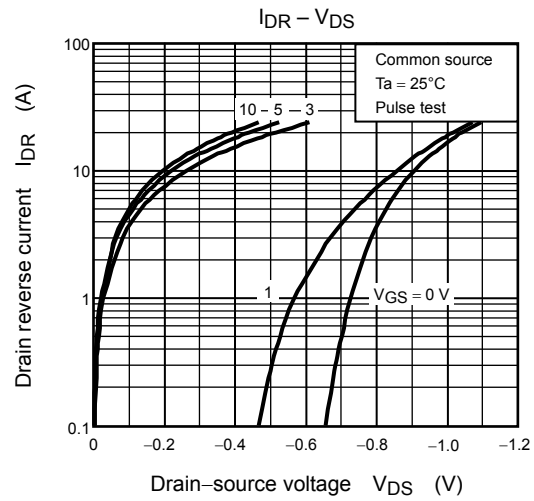
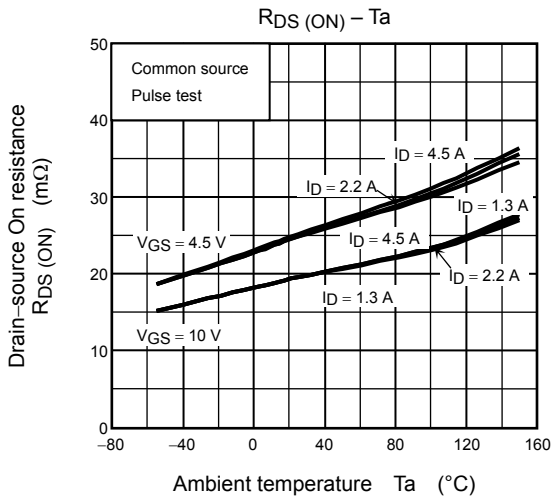


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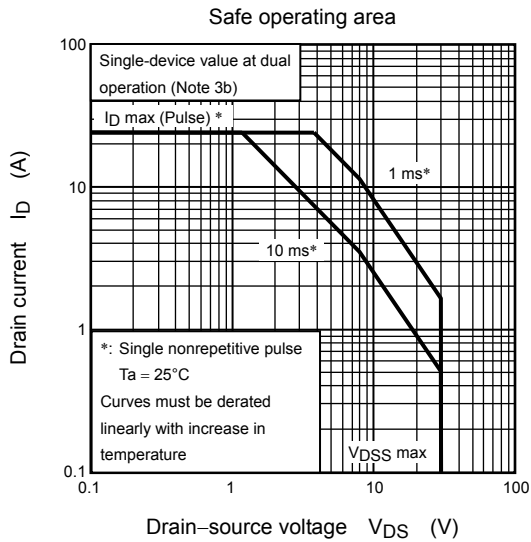
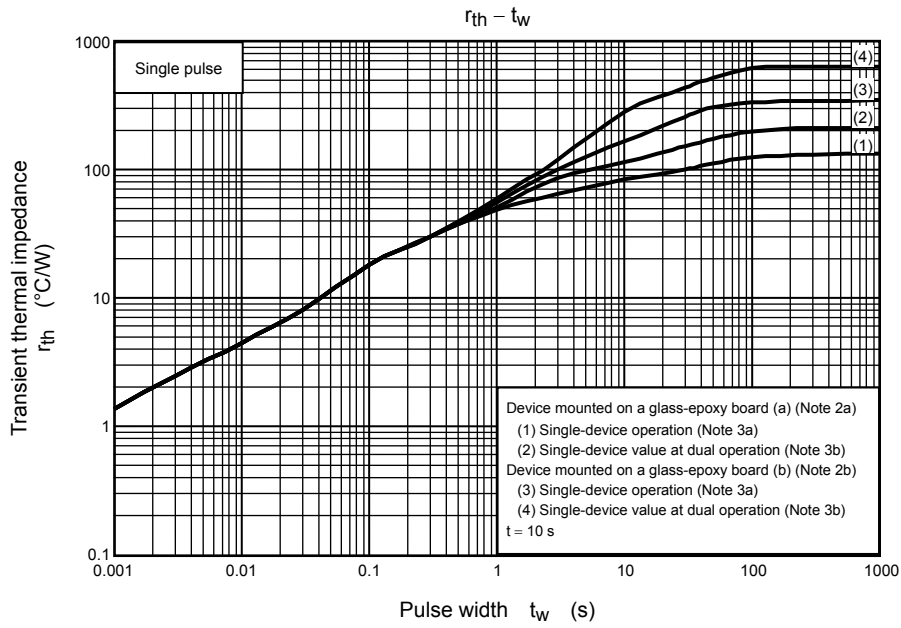




N-ch



**N-ch**



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